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A New Book on Geology.

THERE have been so many text-books of geology that it might well be doubted whether there were at present room for another; but the new volume by Professor Prestwich* may be said nevertheless to have filled a gap, by presenting us with a work written in a style that is clearly intelligible, not only to the scientist, but to the ordinary reader. More particularly is this the case when the author is dealing with questions of economic importance.

Several parts of the work are decidedly novel, dealing fully with subjects which in other text-books are only just touched upon. Its principal aim is to place before students the views of the Continental and American schools of geologists, who uphold the theory that the physical forces were more active and energetic in former geological periods than at the present time. In this country the theory of uniformity has been more generally held and taught; by which we mean, that there has, within certain limits, been uniformity of action in all times. There are important objections to the latter theory, one of which is well put by the author in the passage in which he observes (p. 285) that, "Whereas Continental elevation may take place with or without fracture, mountain elevation is always accompanied by powerful fracture and excessive lateral pressure. Both forms of upheaval are due to the operation of the same subterranean forces; but while we have knowledge, within our own experience, of the operation of the former, we have, within the same experience, no knowledge of the latter, and can only judge by inference from the facts of its mode of action." It cannot be denied that the inversion and contortion of several thousands of feet of strata in the formation of mountain chains form, at all events, one strong argument in favour of non-uniformity; and it may be observed that the tendency of recent scientific theory and investigation has been to support the idea, in regard to other branches of the physical history of our planet, of a great difference in the energy and action of some forces from that which we now see; as, for instance, in regard to ancient tidal action, about which such new and startling hypotheses have been lately brought forward. We can hardly, however, agree with the author that the denudation of rocks has gone on at a more rapid rate in past geological periods than in the present (p. 61). We do not stretch our imagination in this respect back to the times when the Archæan or pre-Cambrian rocks were originally deposited, because none of us know enough about the actual conditions under which they were laid down, or of the chemical and physical forces of the time, to say anything which might be of any value in the determination of a point of this nature. But we would rather begin with the Cambrian rocks,—the earliest strata of Palæozoic age; and the evidence afforded by their entombed organic remains, together with that of their method of deposition, leads us to think that the condition of the atmosphere and the water at that remote period was very similar to that which now obtains; and, therefore, the rate of disintegration did not proceed more rapidly then than now; for, of course, the supposed period of violent and tremendous tidal action, when the moon was much nearer to the earth than now, must be relegated to a period far before that of the Palæozoic strata; and, if we go on thus admitting the existence of extreme forces in past geological times, we shall not be arguing from analogy of things as at present observed. We might stretch a point in this direction with regard to the elevation of mountain chains, as the evidence afforded by them seems to warrant it; but the contents of the stratified rocks forbid us to be so elastic with them.

To turn to some of the points which more directly concern our readers, we may observe that while all text-books of geology tell us something about underground waters, springs, and so forth, we have never seen one which deals so exhaustively with matters relating to water supply, as understood by practical men, as the work now before us. We must heartily congratulate the author on his method of dealing with this portion of his subject, and recommend its perusal to those of our readers who are interested in water-supply questions.

After explaining how rain is disposed of when it reaches the surface of the earth, the absorbent power of rocks, and their capacity for holding water, are dealt with. In regard to this, Professor Prestwich observes (p. 156) that the quantity of available water which the strata may contain has to be looked upon as distinct from that which a rock can imbibe. The one is the portion which the rock holds until it is lost by evaporation or is driven off by the heat, while the other is that which passes more or less freely through the strata. The latter is the condition which prevails when the strata are below the line of permanent saturation, and the former is that which obtains when the rock is above the line of saturation. The one may be called the "water of saturation," and the other, which is held by capillary attraction, the "water of imbibition," or the "quarry water." Percolation is a property dependent on both conditions jointly.

Tables showing the amount of absorption of rocks of different natures are given, and the comments on the value of the experiments carried out, in arriving at the results, are exceedingly useful. The author remarks that the full absorbent power of a rock does not represent its value as a water-bearing stratum. Clay can absorb a large quantity of water, but transmits none. Chalk, again, absorbs freely, but transmits slowly and in small quantities. Laboratory experiments made on compact unfissured samples, which do not correctly represent the amount of water obtainable from their respective rocks when *in situ*, are shown to be of very little value; as in nature such rocks are traversed by joints and fissures, which hold and transmit water freely. The value of the beds, as water-bearing strata, is in direct ratio to their capacity of saturation, and in inverse ratio to their power of imbibition. Thus, although solid chalk and loose sands may hold the same quantity of water, the resistance to the free passage of it in the former is to the latter in the proportion of about 600 to 1.

The phenomena attendant on springs, and the conditions for the successful making of artesian wells, follow in due course. Speaking of London water-supply, the author states that, although the necessary conditions are present to cause water to rise above the surface in the lower grounds of the valley of the Thames, yet owing to the multiplicity of artesian wells, and to the drain upon the underground water, the inflow of the rain and surface-waters cannot keep pace with the quantity removed by pumping, and consequently the line of water-level has been lowered, and now stands under London about 100 ft. below the Thames level. Several good diagrams illustrate the more essential points connected with this subject, and there is also a coloured plate showing the underground water-level in different parts of the south-east of England,—vertical lines indicating the positions of important wells. We would particularly call attention to the fact that the majority of the sections which illustrate this and other portions of the work represent actual sections of ground; and are not drawn—as many such diagrams are—to show what is possible, but what actually occurs in nature, and what is found in practice.

The chapters treating of volcanoes and earthquakes, which have just become a painfully interesting subject, are written in an entertaining manner, and much new matter is

* Geology: Chemical, Physical, and Stratigraphical. By Joseph Prestwich, M.A., F.R.S., &c., Professor of Geology in the University of Oxford. Vol. I.—Chemical and Physical. Oxford: Clarendon Press. 1886.

added. An important point which is touched upon is, that though earthquake shocks (p. 221) are propagated with greater rapidity through solid rocks than through those which are soft and friable, yet the effects on buildings situated on the latter class of strata are far more disastrous than when they stand on hard and compact rocks. Evidence proving this is cited from the Jamaica, Tuscany, and Lisbon earthquakes. In the earthquake at the last-mentioned place, the buildings on clay were all destroyed; those on the slopes of the Almada sands and limestones suffered severely; whilst, on the contrary, all the buildings on the Hippurite limestone and the basaltic rocks escaped entirely; the line at which the force of the earthquake ceased to be destructive corresponding exactly with the boundary of the softer and less coherent Tertiary beds. The solid rock, we presume, like Wordsworth's cloud, moves altogether if it moves at all, and the ground does not shake under the shock to the same extent as on softer and more friable strata. In dealing with this part of the subject, more reference might have been made to the recent seismological researches in Japan.

The geological map of the world, which forms the frontispiece of the work, is, for its size, decidedly the best we have seen; the colours are remarkably clear. Other plates are given, showing the distribution of the active and recently extinct volcanoes, and of the areas affected by earthquake shocks, with approximate contours of ocean depths; maps of coral islands, reefs, &c.; sections across the coal-fields of Somerset, Liège, and Westphalia; and a section of Mount St. Gothard, as shown by the tunnel, &c.

The author states that much of the volume has been some time in print, and this may account for the work not being quite up to date in some respects. Students of the subject may look forward with considerable interest to the appearance of the second volume, which will deal principally with stratigraphy and historical geology. We are, of course, bound to consider the subject as it bears on practical studies, rather than from a purely scientific standpoint; but it may be added that, apart from the high intellectual interest of the subject, the architect who gives some attention to geology will be likely to find it assuming practical relation with his work at a good many unexpected points.

A SANITARY RETROSPECT.

(CONCLUDED.)

IT was a matter of common knowledge that the sewage so freely poured into rivers contained valuable fertilising elements, and the first attempt to clear the rivers arose from the consideration of the value of the sewage, although the fouling of the river could be dealt with under the Nuisance Removal Act if any one would take the proper course; but it was one so uncertain of result that proceedings were seldom taken under it, and it could be dealt with by injunction of the Court of Chancery, and this proceeding has been frequently taken; but any willing action of town authorities to clear the rivers was taken chiefly to recover the value of the manure of the sewage before it passed into the river. It was supposed to be contained in the rich-looking mud, and it was the purpose of the town authorities to recover from the sewage its manurial value in the form of mud dried and made portable, the first proceeding being to construct tanks at the outfall in which the mud might settle, and to make them in two parts so that one might be filled while the other was being emptied. The subsidence of the mud was a slow process, and even after the sewage had stood for some time in the tanks the lighter particles of solid matter remained suspended in the liquid. This was caught before it could enter the river by passing the sewage through rough filters. To make filtering unnecessary the precipitation of the solid matter in the tank was hastened and made more perfect by mixing with the sewage a small quantity of lime, and after the sewage water had been run off the mud was taken out and dried in the air, ready to be disposed of as manure. From 15 cwt. to 20 cwt. of lime, according to its quality and the greater or less quantity of solid matter in the sewage was used to each million gallons of sewage dealt with, or from twelve to sixteen grains of lime per gallon.

The action of the lime on the suspended matter soon made it fall to the bottom, and when the water had been run off the mud was spread out to dry within banks of earth or dried mud formed round the place to confine it. Out of each million gallons of sewage so dealt with, about twenty tons of this sludge would be got out of the tanks, which would be reduced to four tons by the time it had dried sufficiently to be removed; that is, reduced to the condition of stiff mud, which could be dug out and carted away. But farmers were not long in finding that it was of very little value as manure, and they would not take it away from the place at any price, unless something of real value was offered along with it, such as the sweepings of the streets and markets; and the sewage mud accumulated on the hands of the town authorities to a most inconvenient extent. They could no longer let it run into the rivers, having once made the attempt to take it out, and could not dispose of it in any other way. But chemists found from analyses of raw sewage that the chief part of its manurial value was contained in the liquid,—as much as six-sevenths of the whole,—and this information placed the question in a new light. Land had for many years been irrigated with river-water in various parts of the country,—in almost every county,—and the dirtier the water the better it was for this purpose. Where land was irrigated with river water, every effort was made by the owner and occupier to get into the watercourse as much sewage as possible, along with which would travel two tons of mud in every million gallons, if it did not settle in the watercourse on the way to the fields, and in this way the two tons of mud could be dealt with; whereas when it contained only two more tons of water in the form of portable mud at the sewage works, the four tons of so-called manure offered to the farmer was not worth fetching away. Farmers do not, as a rule, go much from home, and except in these isolated cases of land irrigation, they knew but little about it. They were, indeed, well acquainted with the use of the liquid manure of farmyards, carried about in a barrow, or iron tank, and did not find it pay the expenses attending its use in that way, and they did not readily fall in with suggestions to irrigate land with town sewage as a permanent thing, notwithstanding that chemists proved beyond doubt that it contained nearly all the manurial properties they so much wanted, and were paying high prices for in another form; and they were assisted in their objection to sewage utilisation by the artificial manure manufacturers and agents, and perhaps some chemists. Town authorities, then, having proof of the beneficial use of sewage on land by way of irrigation, desired to possess land for the purpose, either by purchase or lease. But this could not be done on any fair terms. They wanted an acre for every hundred head of population of the town; 100 acres for 10,000 people, and so on; but whether it were a large area or a small one it could not be had at its agricultural value. Almost the price of building land had to be paid for it a mile from the town. Land which had not been improved by any outlay of the owner or his predecessors in possession, but had become more valuable by the presence of the town population, must be paid for by those who had themselves increased its value, at a price which could not accrue as the true value for a century, on any reasonable calculation; and a lease of land for sewage irrigation was almost equally difficult to obtain. There was a prejudice against land irrigation with town sewage, a prejudice founded on no knowledge of the facts of the case. Sewage had been used for many years by farmers in the immediate neighbourhood of towns without the least nuisance being created,—omitting all reference to the so-called Craigentinny "meadows," of which perhaps that could not be said,—so that, with respect to the chief objection, which was that the irrigation of land with sewage would create a nuisance in the neighbourhood, it was not founded on any sufficient grounds, and was merely introduced to enhance the price to be paid for the land if taken. The Sewage Utilisation Act of 1865 was passed chiefly to facilitate the acquisition of land for this purpose, and it offered some facilities for putting in force the Land Clauses Consolidation Act of 1845, whereby on giving certain notices lands may be taken otherwise than by agreement, either on a trial by jury or by arbitration; but that Act was never made for the taking of land for sewage irrigation; it was made for railways, canals, docks, and similar works, and chiefly had in contemplation the taking of land compulsorily for railways; also for waterworks, but in no case for the disposal of sewage; and the requirements of this are of a nature different to those of the other kind of works. There is no element of public necessity in a railway: convenient it may be: it is for the Parliamentary committees to inquire whether it will accommodate a sufficient number of persons to warrant its being made, or rather, as this point may almost safely be left to the consideration of the promoters, to inquire what interests of a public nature it might interfere with if made; and if nothing of this sort would take place a railway might be called a public convenience. But even on that very point it may be asked as a bye question, and not immediately connected with our pressnt subject, whether, if a railway company, for no other reason than that of increasing its dividends, destroys the traffic of the canals—not by competition, but by their purchase for the purpose of closing them,—and even lets them go to decay so that the traffic would be difficult of revival, that railway can be said to be a public convenience, and also whether that railway company is honestly carrying out the powers given to it by its Act of Parliament. Those persons who are deprived of their whilom convenience of canal traffic, though it be but a moderate one, may well ask whether such a company really took from Parliament the powers it has exercised in this respect. Whatever justification there may be for depriving some persons of their accustomed privileges for the sake of increasing the convenience of others, it ought to be made known. Let the same argument be applied to the powers which a town authority has to take land for sewage irrigation. It may be said that a landowner is deprived of a part of his land for the benefit of the people of the neighbouring town, and that they ought to pay for it in the same manner and on the same scale as a railway company must do, with the exception of the claim for severance. The answer is,—or, at least, one answer is,—that the owner of any land adjoining a town shares in the prosperity of the town. If by the health and industry of a multitude of people the town grows in prosperity, the land immediately adjacent becomes more valuable, and, for building upon, a high price is readily offered for it. This, in all fairness, must be regarded as going some way towards compensation to the landowner. There ought to be a revaluation of all lands near towns, and where it is proved that the increased value arises from the proximity of the town population, a part of that increase ought to go towards providing land for the disposal of the town sewage. It is not wanted close to the town or to interfere in any way with building sites, or within any distance to which building land can be reasonably said to extend, and an offer of the agricultural value of as much land as is required for the disposal of the sewage a mile from the town ought to be accepted. In some cases the question of residential injury arises. Innocuous as the irrigation of land with town sewage is, with ordinary attention,—and this must be accepted on all hands as a *sine quâ non*,—there has always been a sort of objection to it fancied by those who reside near the land before anything is done; but afterwards, and when nothing is seen but ordinary farming movements of horses and carts, the same

people forget there is any such thing as irrigated land near them.

The drift of the Sewage Utilisation Act of 1865 was pretty plain,—that it encouraged the disposal of town sewage by way of land irrigation; and it was followed in the next year by the Sanitary Act, which, amongst other provisions, entertained the possibility of the wilful default of a local authority in providing sewers and water supply, and in such a case made provision for these being carried out. The Act was passed in August, 1866. In October a Sewage Congress was held at Leamington, at which two chief questions were discussed: whether it were better to dispose of sewage by way of irrigation,—meaning that ordure of all kinds should be carried out of the town by water, as well as the refuse water used in houses for all purposes,—or whether the fæces and as much of the urine as was discharged with them should be dealt with separately by a "dry" system. There was the Town Clerk of Manchester, Mr. (now Sir) Joseph Heron, who supported the system which had always been and was then adopted in Manchester, which kept out of the sewers and the river Irwell as much as could be retained on the premises of houses, to be removed in carts in the night time, mixed with part of the ashes of the house fires, and sent into the country as manure, the difference between the charges for carriage and that received as the value of the manure being debited to the funds of the Corporation. It was admitted that this was but a rough-and-ready way of getting rid of the human ordure of the town, and that the details might be improved, but in principle the "dry" system was upheld. Dr. Alfred Carpenter and Mr. Baldwin Latham, on the other hand, supported the system of irrigation as the best in general, and it was resolved by the Congress, "That the system of irrigation, when carried out in a scientific manner, removes the difficulty which arises from the present noxious plan of polluting the rivers of England, but that no one system can be laid down which would be suitable to all towns," the latter part being a rider imposed upon Dr. Carpenter's resolution to appease those who opposed irrigation in the interest of large towns like Manchester, the difficulties of which in dealing with the sewage by way of irrigation are those only which are entailed as a consequence of covering too much ground without a break,—land again, every inch of which must be sold for as much as it will fetch. An outfall adopted for a prospective increase of population of 50 per cent., or even double, has been made use of for an extension of population to three times the number. Where, it is asked with something like scorn, and with an evident assurance that the question cannot be answered, are the 3,000 or 4,000 acres of land required for irrigation? Having made the difficulty, not without some warnings against it, the large town appeals to its magnitude as a reason for letting it alone.

WORKSHOPS AT PUBLIC AND PRIVATE SCHOOLS.

A HEAD-MASTER, newly appointed to a public school, in his inaugural speech remarked to the assembled boys that one new thing he would promise them, and that was a workshop. This is an observation which we should like to see made by every head-master of every public and private school in England. In some schools workshops already exist, and it may be hoped that some day or other a workshop will be considered as necessary an appurtenance of a school as a sanitorium. It is not so very many years ago that the latter would not have been regarded as a necessity; now, in some form or other, such a place is part of every well-regulated school.

The advantage of having a workshop attached to a school is almost too obvious to need pointing out; but the fact that there are many schools which do not possess one, seems to show that the advantages, though obvious, are not so generally recognised as they should be. The usefulness of a knowledge of tools, and of the way to apply them, is continually of benefit in after-life. No boy can tell in what way he may require them. It may be that, like Mr. T. Hughes's nephews, whose letters he has published in "Gone to Texas," he may have to leave school somewhat suddenly, and in no long time have to go to some new country to earn his livelihood. The advantage of having acquired even the smallest dexterity in the use of tools is then most clear. But every one who lives in the country, and also in the town, may every year save himself no inconsiderable sum of money by knowing how to handle tools. It gives him, too, a better opportunity of seeing that work is properly done in a house than is usually the case, when most heads of households give *carte blanche* to the neighbouring carpenter.

If a man likes to do more with them than simply make use of them, he at once has a capital amusement as a set off-against mental labours. There are some who in leisure hours will amuse themselves with their pencil; there would be many more who would take up the hammer and the chisel if they had been early taught how to use these and similar tools. Coming back, so to speak, to school-boy days, there is nothing better than to give boys the means in holiday time of making their leisure hours at once hours of rest, but not of mere idleness, or of absolute devotion to some athletic pursuit. If a boy has tools and a place to use them, and materials on which to employ them, the number of hours which may be thus healthily and usefully spent are considerable. Most persons have seen this fact, it is only to be regretted that it is not one which can be more universally recognised.

The primary cost of a workshop is not great, and there is no school which can be without the space in which one can be erected. The supply of tools may be of a twofold character. If the shop is of some size, and lathes and larger standing tools are required, they should be, so to say, part of the shop. It may be well also to have a general supply of some of the tools which are most commonly used, just as the school cricket club supplies a certain number of bats, pads, and gloves. But that should not prevent boys who desire it from having their private tools, just as they have their private bats or rackets. As, too, in every school there is a small subscription for the club, so there should be a small subscription for the workshop. But as the school body, or the proprietor of the school, if it be a private one, supplies the ground, so also should in the same way the workshop be supplied. There would never be any difficulty in having a man to superintend it; in a large school it would be a sufficient employment for him, and in most cases he would from time to time find work to do in the establishment itself. The workshop once being established, its development as regards size and work would depend on the size and character of the school. It might be a mere carpenter's shop, or it might comprise much more elaborate work in wood and metal.

The use of the workshop would, of course, be confined to play-hours; but the space of time in which it would be available would then be considerable. There are in every school-boy's day a number of odd half-hours which are generally wasted. These would be the special time for the workshop; but on half-holidays there would always be time, and on rest days in winter, or such occasions when football and the regular out-door games, which, after all, at that season of the year occupy little more than an hour a day, could not be played, the workshop would be available. It would be impossible for us here to work out the plan of its use with any minuteness. To do so would necessitate a knowledge of the school system of every public and private school in England. Our object here is to point out the advantages,—we would almost say the necessity,—of a workshop, and the fact that it is possible to establish one in a school without difficulty. The fact that in some schools workshops are already to be found is evidence enough that they can be both established and used. As regards those schools where they do not exist, we would urge those in authority no longer to overlook their value or to delay in establishing them.

NOTES.

NO one has yet hinted at any possibility, present or future, of controlling the action of earthquakes, but the recent calamity in the States has led to the publication of various suggestions as to the possibility of estimating the periodicity of earthquakes or arriving at some idea of natural law in regard to their recurrence. The most striking of these is embodied in Mr. Jenkins's letter in the *Times* of the 8th, giving facts and dates which go to indicate that there are tides in the internal fluids of the earth influenced by the moon in the same manner as those of the external fluid. Part of the letter is worth quoting:—

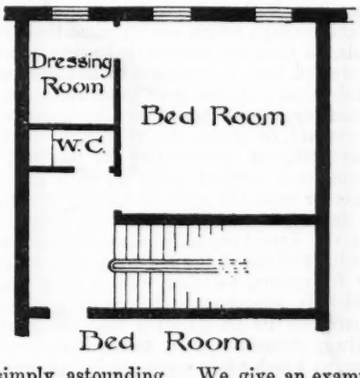
"Between August 26 and September 3, 1878, earthquakes and volcanic eruptions occurred in Germany, Holland, Belgium, and Italy, the centre of the disturbed area being in lat. 50 N., long. 10 E. At the same time earthquakes and volcanic eruptions occurred in the Aleutian Islands, which are situated on exactly the other side of the globe. The moon at the time was new and in perigee.

Between August 26 and September 3, 1886, earthquakes and volcanic eruptions occurred in Europe and America, both again in the same latitude, and both in a south-eastern direction from the areas affected in 1878. The moon at the time was new and in perigee.

The difference in time between these two sets of events is exactly eight years. But eight years is the time that the tides of the external fluid take to repeat themselves. Do not the above instances show that eight years is the time the tides of the internal fluid take to repeat themselves?"

It may be questioned, however, whether it is any particular consolation to have reason to think that earthquakes will recur at a certain time and quarter. If it would help us to deal with the earthquakes, well and good; but as we are helpless in that respect, and probably likely to remain so, scientific prediction seems a very doubtful consolation, except so far as this, that if it be shown as a reasonable probability that earthquakes are likely to become more frequent and to affect parts of the world hitherto (like our own island) little affected by them, the methods of building must be modified to meet the circumstances.

IF the time ever comes when Government, as has been proposed, takes a more active part than at present in overseeing the sanitary condition of houses, and when ubiquitous Sanitary Inspectors may have powers given them, of their own proper motion, and without waiting for complaints, to come down upon those malefactors who let unsanitary houses to the detriment of their fellow men, such officials will find glorious opportunities for a great sanitary crusade in the district which includes, as auctioneers phrase it, "all those very desirable" squares and streets lying between Holborn, Euston, Tottenham-court-road, and Gray's Inn-road. The sanitary planning of a great proportion of these houses



is simply astounding. We give an example from the houses in one of the best and most popular of these squares. In the same houses the servants' w.c. is an absolutely dark cavern, opening off the lower staircase. This is only one out of many such instances, and it may be

observed that some of the best of these squares in outward appearance and the style of the houses are the very worst in this matter of sanitary arrangement. In one case we found a central water-closet lighted by a window opening into a bedroom. In other cases dark closets under the stairs, offensively prominent in position, and without the smallest ventilation, or with "ventilating openings" on to the well of the staircase (!), are the only provisions in houses for which high rents are asked, and considerable premiums charged for entrance. It would be curious to know the medical history of some of the generations who have lived in these houses. Probably they suffered from many diseases which they resignedly attributed to "Providence." Persons taking houses in this neighbourhood now-a-days, however, will be wise to be less resigned, and to refuse to enter any such habitations until their interior arrangements have been thoroughly remodelled in accordance with modern sanitary knowledge.*

THE last new company that has been formed will, if successful, do more to advance the cause of domestic electric lighting than any other in that prolific field. The present undertaking is that of the Regent Portable Electric Lamp and Lighting Company, which dispenses with the difficulties and cost attending a dynamo and engine, by placing the primary battery within the pedestal of the lamp. According to Professor Fleming, we have here the essential parts of a domestic lamp, viz., great portability at small expense, freedom from complication of pipes and the circulation of fluid, a capability of being supplied with a ready-mixed exciting solution which is able to keep up the constancy of the battery to a remarkable degree, and absolute safety for servants and those who have to handle the lamp. If all these promised blessings are verified, a millennium is at hand for the British householder, who, in nine cases out of ten, enjoys a light of more or less noxious vapours, provided at a maximum of cost. For mining purposes, where there is danger from explosive gas, these Regent lamps should be simply invaluable, for even if the glass were broken, the vacuum would be destroyed, the carbon filament consumed, and the light extinguished.

THE Lartigue railway, about which a good deal has been said during the last two or three weeks, is only an inferior and more cumbersome application of the principle of the late Professor Fleeming Jenkin's invention of the telpherage railway, a railway carrying the goods balanced panier-fashion from a single central rail above the centre of gravity; only that the Lartigue is intended for locomotive rather than for electrical working. The elevation above the ground of its one central rail is only about 3 ft. 6 in., the rail itself being supported by iron trestles, the feet of which are fastened to light iron sleepers. Steep gradients are provided for by a rack rail in addition to a central rail; and inequalities of surface, such as ravines, by heightening the trestles as required. Guide-rails are fixed to the sides of the trestles on each side, right and left, as an additional security. Both engine and carriages have horizontal pulleys, which work against their guide-rails, so that the normal balancing power is protected from disturbance by anything which might tend to throw it off its equilibrium. As a railway it may be worked by horse-power, electricity, or steam, the engine in the latter case being as rudimentary as possible, consisting of a vertical boiler on each side, and, together with the cylinders, hung on a couple of driving-wheels running on the central rail. On the experimental line at Westminster a gradient of one in ten is shown, with curves of 49 ft. radius, together with a long viaduct, which is supposed to be crossing a valley. There can be no question that the Lartigue railway presents a ready means of communication, in which a fair speed can be obtained at a very small cost; and, when we add that the system is portable, it is evident that its application for temporary purposes, military or industrial, and its singular adaptability to any form of motor power will secure for it an extensive field of usefulness. The Lartigue railway has passed the theoretic stage, being in actual operation in Algeria and the south of France.

* In Gower-street, we observe, this is being done to a considerable ex'ent.

WE have noticed from time to time the disputes which have taken place at Bath in regard to the treatment of the Roman bath remains, in connexion with the proposed extension of the modern baths. It appears that the Committee of the Corporation of Bath who are concerned with the subject invited Mr. Penrose to visit and report upon the City Architect's plans in connexion with the Roman remains. Having carefully inspected the remains, and read the report of the City Architect, Mr. Penrose has reported decidedly in favour of the scheme of the latter. Being an architect as well as an archæologist, and not an "anti-scrape" sentimentalist, Mr. Penrose took the practical view that "the primary duty of the Corporation is to make the healing waters of Bath available for those who require them; the secondary but still very important one is to see that in so doing no unnecessary destruction or loss should take place of the valuable and unique historical records of which they are the trustees." Mr. Penrose considers that the City Architect's plans have sufficiently provided for these two objects. None of the Roman walls, he says, are to be destroyed, and no parts essential for the understanding of the original plan are even to be lost to view. "The new walls are to be built upon the old, and so constructed that the ancient work, wherever any exist, can be easily identified by the archæologist." There is no one whose judgment we could more safely accept than that of Mr. Penrose on such a subject, though we observe that (according to the *Bath Chronicle*) "an attempt is being made to depreciate the report by denying to its author antiquarian skill." Is there such a thing as a library in Bath? If so, the gentlemen who seem so much at sea as to Mr. Penrose's acquirements had better repair to it, and ask for his celebrated work on Greek architecture, and enlighten their minds a little.

IN a supplementary circular to the competitors, the Corporation of Edinburgh have stated that "it is their intention," if any one of the designs sent in be actually carried out, that the author of it should be employed to carry it out, but that the power of absolute decision on this point they reserve "unqualifiedly" in their own hands; and with that, we presume, competitors must remain content.

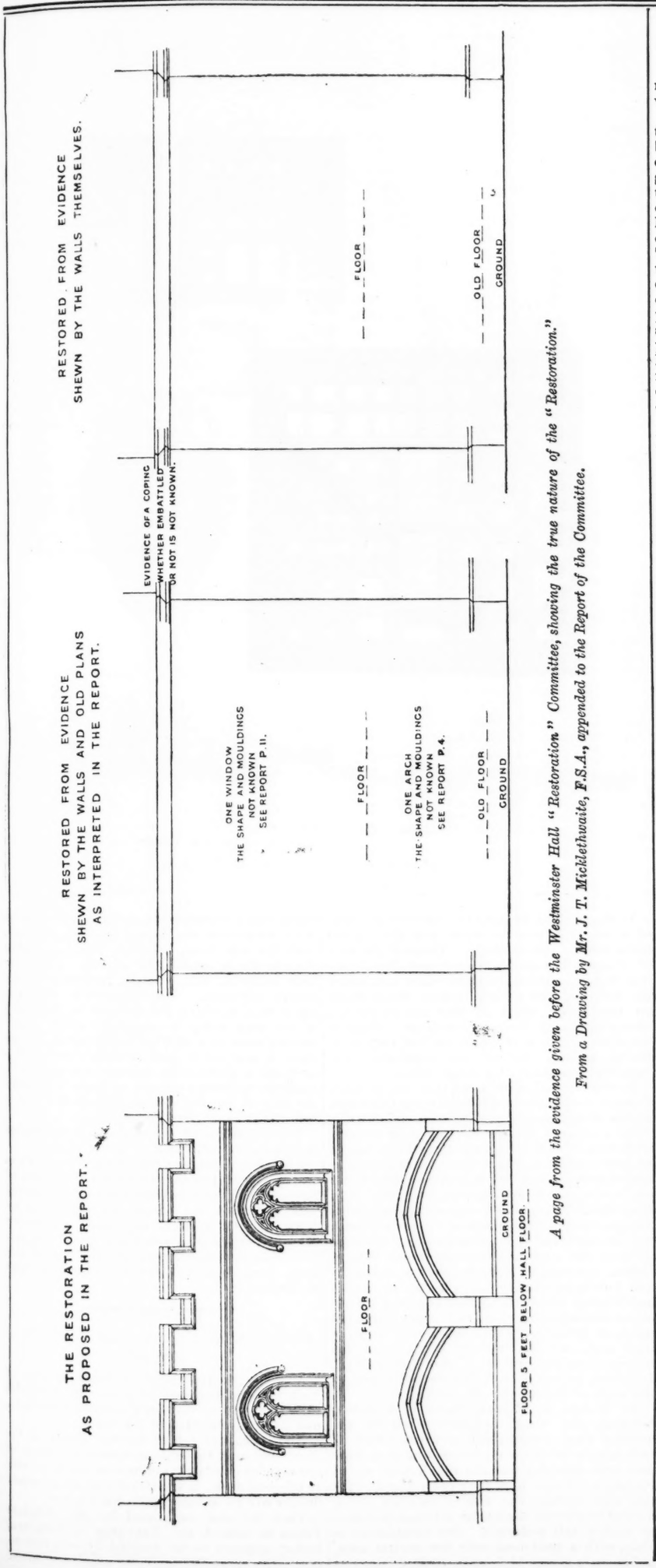
THE Richmond Vestry, though engaged in actively prosecuting the movement in favour of the purchase of the Buccleuch Estate, is not allowing its drainage scheme to be pushed out of view; and has entered on a course of diplomatic action which has, probably, removed the most formidable opposition to the scheme. The Duke of Devonshire and the Pullman Trustees are owners of land at Grove Park, on the Thames, opposite the proposed site of the sewage works at Mortlake. The representatives of the Duke and these Trustees purchased about half an acre each of land on the Mortlake side of the river and near the proposed site in order to give them a *locus standi* in opposing the scheme. The Richmond Vestry has bought these two half acres of land at 500*l.* each, both owners undertaking to withdraw their opposition to the scheme. 1,500*l.* is to be paid in addition to an extensive local market gardener who has agreed for this sum to plant an acre of his ground with trees so as to screen from his view the sewage works. The Vestry and the promoters generally of the scheme are sanguine that by this diplomatic arrangement the opposition to the scheme at the forthcoming inquiry of the Local Government Board will be of a comparatively harmless nature. We hope the Vestry will be equally successful in the matter of the Buccleuch estate.

FOR the present, at all events, and probably for some time to come, the vexed question of the establishment of a Convalescent Hospital for Smallpox cases at Darenth has been settled by the refusal of the Local Government Board to consent to the erection of permanent brick buildings. The Board prefers that the hospital should take the form of huts, remarking that there are already in the South Camp sufficient administrative buildings for 1,000 patients. There are also, as well as in the North Camp, wood huts and several wood platforms, capable of bearing tents, which would accommodate at least 800 patients. The sewage question, which under the Metropolitan Asylums Board's proposal would have been attended with considerable expense, is considered by the Local Government Board to be satisfactorily arranged for by earth closets, which will cost next to nothing, and will be attended with no inconvenience; while as to general expense, the Whitehall officials point out that the providing for 600 patients by the existing accommodation will equal the interest payable on the 116,000*l.*, the estimated outlay for the permanent hospital. Although the refusal was naturally not a *litera grata* to the Asylum Board, we are of opinion that Mr. Ritchie has made out an exceedingly good case for economy, for which the ratepayers ought to be duly thankful.

OUR attention has been drawn to a sewer gas destructor patented by Mr. Hartley Fewson, of Buckingham, the object of which is to draw the air from the sewer by a rotary pump and pass it through an electrical apparatus, by the action of which the noxious gases are decomposed and form fresh combinations, oxygen being liberated and ozone formed. The apparatus would, we have no doubt, perfectly purify any foul air drawn from a sewer and passed through it, and, therefore, it would answer the purpose as far as it would act at all, but as there are numerous openings along a sewer through which atmospheric air would pass to replace the air drawn out, the effect would be that instead of the foul air being drawn along the sewer for any considerable distance, as desired, the air which would pass through the apparatus would chiefly be drawn from the atmosphere through these openings right and left of it; and to have any practical effect in destroying the foul air of sewers the destructors would have to be very numerous. The invention must, we fear, be relegated to the large number of inventions which are very ingenious, but not calculated for practical application on an extended scale.

THE best point in Mr. Maddison's opening address at the Trades Union Congress was the suggestion that some of the at present waste land of the world should be occupied, under Government supervision, by those who were willing to work and could find no market for their labour, instead of emigration to the Colonies and consequent flooding of the labour market there. The practical difficulties of such enterprises would, no doubt, be very great, and would require Government aid to carry them out at all; but the results might be beneficial to the world at large. The address, unfortunately, was characterised by the same kind of false and delusive reasoning on other points which we are always sure to hear at these congresses. We have again the old argument for the eight hours labour movement, that it would give employment to half a million more people,—that is to say, that so much more labour and time would be expended in gaining the same results. If that is the argument, why does not Mr. Maddison propose a reduction of labour to four hours, which would throw open employment to so many millions more people?

IN another column we print a reproduction of the very pithy diagram put in by Mr. Micklethwaite as part of his evidence before the Westminster Hall "Restoration" Committee, showing side by side the restoration proposed, the documentary evidence for it, and the evidence on the walls themselves. Readers who have not seen the report of the Committee will thus be able to judge of the real nature of the "restoration" in favour of which it is proposed permanently to disfigure the interior of Westminster Hall, as described in our last.



A page from the evidence given before the Westminster Hall "Restoration" Committee, showing the true nature of the "Restoration."

From a Drawing by Mr. J. T. Micklethwaite, F.S.A., appended to the Report of the Committee.

THE TRIUMPHAL ARCHES OF THE ANCIENT ROMANS.*

THE following are the principal arches which now remain out of Rome. Of those in Italy we will first note some of the best preserved.

At Ancona is, perhaps, the most lofty triumphal arch remaining, the height from the base being about twice the width. It stands on the mole, and was erected in A.D. 115 in grateful recognition of the works undertaken at the harbour by the Emperor Trajan. It is dedicated to him and to his empress, Plotina, and his sister, Martiana. It is built of noble blocks of white marble, and is in very fair condition. The central arch is tall, with a fluted Corinthian column mounted on a high pedestal on each side. The entablature goes square from column to column, but it is broken around the pilasters, which are placed at the angles right and left. The spaces between the columns and pilasters are not pierced with side arches, but have tablets only. There is a lofty attic, which follows the plan of the lower stage. A flight of steps leads down beside the arch to the level of the harbour.

The Arch of Trajan at Beneventum (see illustration) is an admirable work. Erected at the best period of Roman art, the design is excellent and the execution perfect. In design the arch is very similar to that of Titus at Rome, there being but a single wide semicircular arch, the keystone being carved with a figure, and the spandrels being filled with figures of large size adapted to the positions. There are engaged composite fluted columns right and left. The angles have other engaged columns, and the spaces between the two are filled with four tiers of figures, two being large and two being small. The columns stand on a single solid pedestal instead of on two separate ones. The entablature breaks around the angle columns, but goes across from those in the centre. The frieze is filled with figures, and the cornice is composed entirely of enriched members. The attic is tall, and follows the plan of the entablature. It has the inscription in the portion over the central arch, the spaces left and right being filled with figures. There is sculpture on each side below the main arch, as in that of Titus, and the soffit is richly panelled.

The arch called that of Augustus, at Aosta, now consists of a broad semicircular arch of two rings of arch stones, with a label-like architrave above them. Two engaged Corinthian columns, unfluted, on each side, complete the composition, one being at the angle, and the other close to the arch, the space between being filled up by a square panel. The columns stand on a solid pedestal. The entablature goes from column to column, unbroken in the centre, but it is returned around the angle columns. The frieze has the peculiarity of having triglyphs somewhat similar to those of the Doric order. The whole of the attic is destroyed. The arch is detached from buildings, and now spans the roadway of one of the principal approaches into the modern town.

The Arch of Suza has a central opening, high for its width, with a semicircular arch, moulded and springing from plain pilasters with carved caps. At each angle is a fluted engaged Corinthian column, standing on a plinth, the entablature being carried across without any break. The frieze is filled on the faces with well-carved figures. The attic is very low, very much more so than in the other arches already referred to, but the inscription extends along the whole of it.

The Arch of Augustus at Rimini has a design peculiar to itself. There is a wide central opening into a low semicircular arch, having a moulded architrave and impost. On each side is a fluted connexion column standing upon a pedestal of moderate height. The entablature is broken around the columns, and it does not extend left or right beyond them, but goes from column to column at the lesser projection. In the centre, over the arch, the cornice forms a pediment of no great elevation. The angles of the main composition are of plain masonry.

The spandrels of the archway are filled in with circles, and there is a keystone of quaint design with a head carried up into the architrave of the cornice. The attic has a cornice and moulded base, and it has the peculiarity of being of lesser width than the arch itself.

Varying as we have thus far seen the designs to be, there is yet another arch which differs

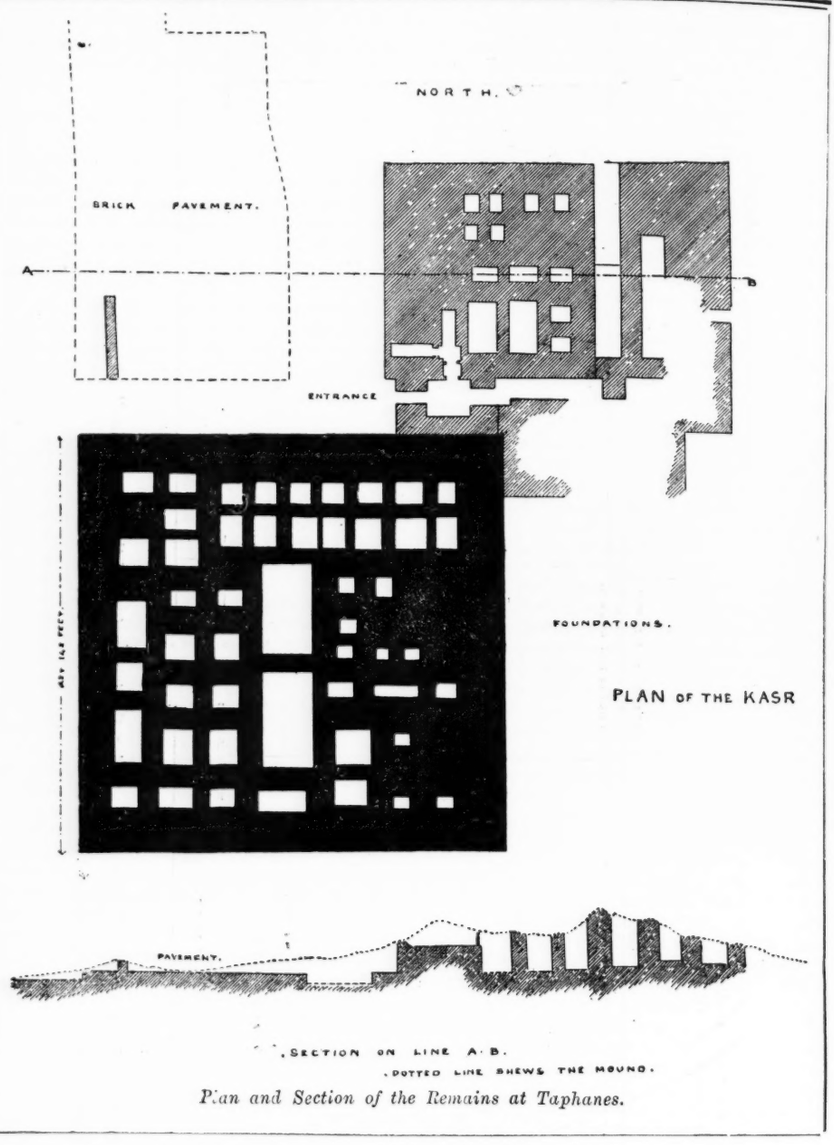
* See p. 333, *ante*.

from them all. The arch at Fano, erected in honour of the Emperor Constantine, consists of a plainly-moulded central arch springing from an impost, having a bull's head in the keystone. There are two plain side openings, the whole composition being a portion of a continuous wall. There is an entablature with a plain dentilled cornice, the inscription being on the frieze and architrave. Above the cornice are the remains of a colonnade, the columns being fluted and intermingled with pilasters for additional support.

The principles upon which the designs of these arches were prepared have not unfrequently been under consideration. This is but as might be expected, for these buildings being entirely of a monumental character, and not dictated by merely utilitarian requirements, it is but likely that they would afford good evidences of any such principles, if they had actually been used. Accordingly, there have been no small number of asserted discoveries of such principles ever since attention has been directed to our ancient buildings. These have been illustrated by systems of diagrams, with combinations of lines, squares, and triangles, more or less ingenious. Probably the best examples of these are by Mr. E. Cresy, in his chapter on proportion, to be found in an easy form for reference in Gwilt's "Encyclopædia of Architecture," edited by Mr. Papworth. It will be seen by these that the Arch of Augustus at Rimini is a single square in height, with the attic in addition. That at Aosta is a little less than a square with the attic as restored. The Arch of Sergius at Pola is a square in height, with the attic in addition, —a proportion not followed in the Arch of Titus and many others. That of Augustus at Susa agrees fairly well with the Pola arch, but some of the others referred to by Cresy require an elaborate system of lines to mark out the proportions; and the student will leave the consideration of the subject with the feeling that none of these systems of circles or squares would give him a definite rule to follow were he desirous of creating a design for a new arch. The point brought out most clearly is, that two diagonal lines drawn from the bases of the design to the extremities of the main cornice give at the crossing the centre for striking the main semicircular arch; but even this is not quite exactly so with the arches of Titus and Beneventum, while to make it apply to the arch of Pola, it is necessary to start the diagonals from below the necking of the plinths instead of from the bases. This rule does not apply at all to many of the arches now referred to. A proportion not unusually adopted for the height of the attic is undoubtedly obtained by striking an arc from the extremities of the main cornice upwards, having for the centre that of the main arch. This proportion occurs more or less exactly in the arches of Titus, Pola, Susa, Beneventum, and some others, there being only such small variations as the height of the cornice of the attic itself being either wholly included or partially excluded. At Pola the architect, not proposing to fill in the attic with panels or lengthy inscriptions, has subdivided it with horizontal lines and projecting piers, evidently to render its height less conspicuous, but nevertheless the general height is given by the proportion named. The inscriptions occur in a very subordinate manner on the faces of the piers and the interspaces, there being no panels to receive them.

The arches now referred to are, perhaps, the largest in number ever named at once; the consideration of their proportions leaves the impression that each one was set out on its own rule, and that there are, therefore, as many rules as there are arches. Did any formal rule exist? And are the diagrams of circles and squares much help to the architect in his work? A snowflake when it falls furnishes us with an elaborate system of geometrical lines, and an architectural design when produced by the genius and intuition of a true artist will undoubtedly bear proportions, one part to another, upon which a system of lines might be drawn after the event with curious results. Is the artist, however, conscious when he designs that these lines will result?

The construction of these arches has received the best skill that their builders had at command to bestow, and our estimate of their appliances must be a high one. The Arch of Titus is formed of blocks of enormous dimensions, the joints are very even and fine, and the engaged columns are of two stones only.



Plan and Section of the Remains at Taphanes.

In the Arch of Severus the columns are each of a single block, the flutes and the entasis being worked very skilfully. Those of the arch of Constantine are in two stones, the jointings being arranged in many cases just below the finish of the reeded flutings which occur on the upper stone, so that the joints are strengthened by their terminations. Many of the other arches named are built of very large blocks, and in that of the Goldsmiths the entablature consists of a single stone.

It may be said with truth that out of Italy there is no country in which so many triumphal arches of real artistic merit remain as France. Their number is remarkable, and their interest with respect to the history of the art can hardly be over-estimated. Apart from the separate detached structures which fall immediately under our notice, there are several buildings of a very similar class, which appear to have been always the entrance-gates of cities or towns, and among these the foremost place must be given to the magnificent three-arched gate at Reims, now cleared from the surrounding walls and buildings. Other examples are at Autun and Nismes, where there were two, and several others elsewhere. In England, while we cannot point, at present, even to the site of a triumphal arch, we can without much hesitation believe that the arches in the Jewry Wall, Leicester, belonged to a fine entrance-gate in the walls of the Roman city, Ratæ.

At Orange, in France, there is a stately building, the most beautiful arch in the country (see illustration), a work which is sufficient, were there no others, to show how pure and graceful was the old Roman art of Provence. There is a bold central arch, with two side arches, the spaces between being divided by elegant Corinthian columns, mounted on rather tall pedestals. The entablature is plain, with a pediment over the central arch, and there is a very high attic divided into two horizontal compartments, and more or less filled with sculptured shields and trophies, standards with the wild boar, captives, arms, and other objects freely and boldly carved. There are four columns, and a large pediment to the return elevation. The proportion does not agree with anything yet referred to, the height of the attic being so unusually great. Many repairs have been effected in the structure, and there is now much modern work visible. The arch has a melancholy interest attached to it, since the guillotine was set up beneath it during the fury of the first French Revolution, and it was the scene of terrible butchery.

The remainder of the more important arches in France we will speak of in our next.

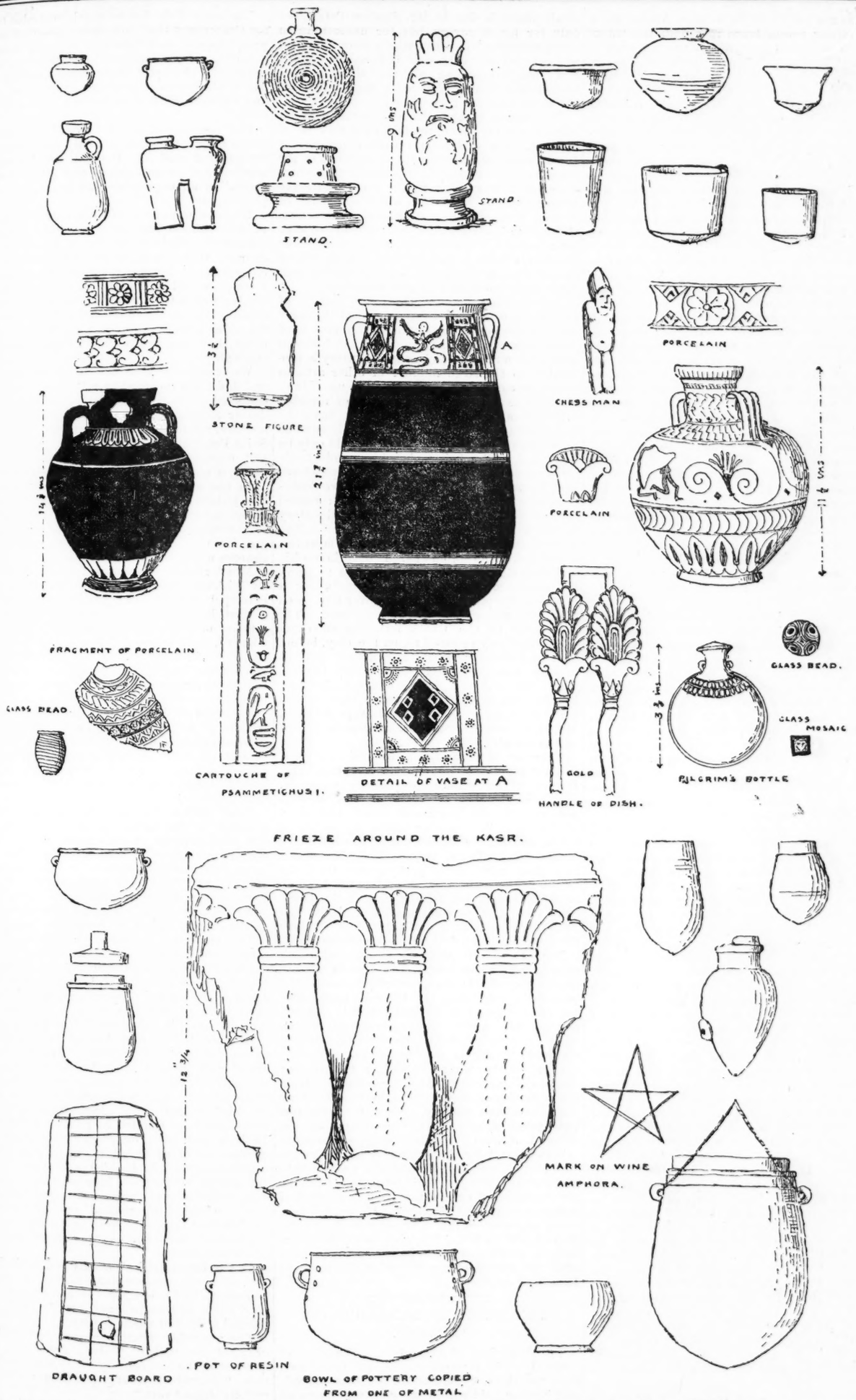
[We should mention that, by a mistake of the lithographers, the page of details of the arch of Septimius Severus, published in our last number, was described as "from an engraving by Rossini." Of course, any one who knows Rossini's engravings would see that it was not. The plate was reproduced, like the view of the arch, from Gailhabaud's "Monuments Anciens et Modernes."].

FURTHER NOTES ON THE TAPHANES HOUSE.

DURING the past week a large number of visitors have inspected the collection of articles which are now on view on Tuesdays, Thursdays, and Saturdays at Oxford Mansions.

The amount of public interest shown in the discovery, and the unique nature of many of the articles exhibited, induces us again to refer to the exhibition, in the belief that some further details will be of interest to our readers.

That the site excavated by Mr. Flinders Petrie is, indeed, the Taphanes of Scriptural history appears to be decided by easy reasoning. The name Defenneh, by which the ruined



Sketches from the Collection of Objects exhibited by Mr. Flinders Petrie, from the House of Taphanes.

mounds are known to the modern Arabs, has a very strong resemblance in sound, the transposition of T to D being not uncommon even in the East, where names are continued through long ages with but little variation. The relation of the site to the narrative of Jeremiah, the flight of the daughters of the defeated King Zedekiah, and their being received with hospitality by the Egyptian Pharaoh, is, however, fixed by the local Arab name, "El Kasr el Bint el Yahudi,"—"the Castle of the Jew's daughter," which at once connects the tradition with the site. The unearthing of what was beneath the surface, revealing that the building was half palace, half fortress, also shows that it fulfilled the requirements of the narrative. The statement already made public, that this is the site of the Daphnæ of the Greek historians is also very likely to be exact. Not only is there the similarity of name, but the site accords well with what would be chosen as the permanent settlement of the Carian and Ionian mercenaries who were quartered there by Psammetichus I. The position, comparatively speaking but a little distance from the seashore, at the commencement, so to speak, of the Egyptian Delta, would have been a good site to select to prevent jealousy by the inhabitants at this foreign occupation. In addition, the excavations have shown that Psammetichus I. was actually the builder of the Kasr about B.C. 600, for his cartouche has been discovered among the foundation deposits, and the position of one of the camps of the mercenaries has been determined. Here were found the largest number of the bronze arrowheads, horses' bits, and such like, which are now included in the exhibited collection.

The general plan, too, indicates where might have been the position of the docks and other topographical features referred to by Herodotus.

We are enabled to publish a plan of the main building, which has been exposed by the pick-axe and spade of Mr. Petrie's Arab excavators. It is the Kasr proper, and will be seen to consist of a square mass of building divided into a series of small apartments. These formed the basement, wherein were the kitchens, cellars, &c., the walls being of very great thickness, formed entirely of sun-dried bricks, and the apartments have been arched over with the same material. Within these chambers were found a large proportion of the pottery shown in the collection, including the pot of resin, many of the unbroken amphoræ, and of the early Greek vases, which are painted with a great number of conventional patterns and archaic figures. The fragments of carefully-worked scale armour were also found here. The position of these objects is of importance to notice, for their early date, all but contemporary with the building, is established by the evidence obtained elsewhere that the Kasr was taken and burned by Nebuchadnezzar according to the prophecy made by Jeremiah on this very spot.

The plan shows the position of other buildings to the north and east. These were, perhaps, of a little later date than the main buildings, but do not appear to have been later than Apries (591-570 B.C.), for nothing later than his reign has been found on the site. It was during this reign that the flight of the daughters of Zedekiah took place (B.C. 588). The entrance was from the north, and in the west face of the added buildings, immediately where it joins the huge square block of the Kasr, is the main entrance. The pavement of brick, over which access was obtained, is also shown on the plan. It would have been the paved portion of the court-yard in front of the entrance. It is to this portion of the site that the position of Jeremiah's prophecy of the destruction of the building appears to be so remarkably confirmed by the Old Testament narrative. Mr. Petrie was able by dint of excavations in many places to determine its general outline as shown. The section indicates how completely the huge pile of buildings has been overthrown, for the dotted line shows the outline of the tell or mound under which it was buried.* The height of the mound above the level of the arid waste of the deserted country renders it a conspicuous object for miles. In considering the nature of the site, deserted and far from roads or means of transit, no small praise is due to Mr. Flinders Petrie, not only for his discovery, but for unearthing so many articles of interest, which were unknown and covered over with sand and mud six months ago, for overcoming all the difficulties of transit, and bringing them to England within the short space of time named.

In addition to the notice of the articles exhibited, already given, the following may be of interest. The excavations have revealed but few remains of an architectural members of the building. It leads to the supposition that whatever relief was given to the huge castle-like building was by woodwork, which would be, of course, consumed in the general destruction. A frieze of limestone, however, appears to have been inserted in the exterior walls, since some fragments have been met with. A sketch of one of these is given, the original having still some faint traces of blue and red colour.

The sketches indicate the great variety of forms of the pottery, and the fixing of the early date of the great bulk of these examples is of great importance, since so little has hitherto been known relative to Egyptian pottery in proportion to the large number of other articles which research has made known to us. Many of the vessels have the peculiarity of rounded rather than flat ends. The amphoræ have the usual pointed terminations for fixing in sand or loose earth; but the other vessels could only be kept upright by being placed in stands, made also of pottery, of which several examples have been found. Some of these vessels have doubtless been suspended by cords, which passed through small handles. The ornamented pottery is Greek in every essential particular. The form of one large standing vessel is, however, a well-known Egyptian one. The workmanship and the painting being Greek, it goes to prove the existence of potters on the spot; for a vessel of Egyptian form would never have been met with abroad had it been imported. The occurrence of the Greek lettering on other vessels, already referred to, on the clay, before baking, indicates beyond any doubt that the articles were made on the spot by Greeks. They are unglazed, inside and out, fawn or lightish red in colour, and made on a wheel. Only a single vessel is of red ware polished, although there are some smaller covers, &c., of this material.

There are some smaller articles of very great artistic beauty, of more usual Egyptian type, formed of the well-known greenish porcelain. We give sketches of some of the elegant patterns on the fragments found, and of a pretty little flat circular bottle, not unlike in form, although smaller than, the pilgrim's bottles of Mediæval times. The glass beads and glass work are of great beauty from the extreme elegance of their patterns. A small stick of glass, about 3-16ths of an inch square, has a small face in colours worked all through its length, so that if cut through in sections the same pattern would be visible at any part.

The Egypt Exploration Fund, although established so few years, has already done a great amount of work, which deserves the warmest recognition. It is to be hoped that the great amount of interest taken in this discovery will result in accession of means whereby some other of the endless fields of discovery in Egypt may be opened, as well as support in other ways being given to this most hardworking society. It is proposed to divide the collection among several museums, as other finds have been already. Since, from the few past years so much has been found by the devoted explorers of this society, we consider it may be well for the scattering of the collection to be reconsidered. At the present rate of increase a few years will be sufficient for the accumulation of one of the most important of collections, if kept together. If divided into many parts, much that may be gained by comparison will be lost. The objects exhibited are only a portion of what has been found even after the claims of the Egyptian Government have been satisfied.

* We are able to reproduce these plans by Mr. Petrie's courtesy, but we have purposely omitted much of the detail, so that they may not unduly anticipate those to be published by the Society. The scale does not permit the enclosing wall of the courtyard to be shown.

THE EPISCOPAL HERALDRY OF IRELAND.

THE Cathedral of Armagh is a building of great historic interest, dating its foundation from the days of St. Patrick (its first bishop), and having held within its walls the "stone of fate," said to have been Jacob's pillow, and which has played such an important part in our annals, and now resting in Westminster Abbe

The arms of the See so closely resemble those for Canterbury that, to a casual observer, there would appear no difference; they are blazoned "Azure: an archiepiscopal staff in pale argent, ensigned with a cross patée or, surmounted by a pall of the second, fimbriated and fringed gold, and charged with four crosses formée fitchée sable."

The heavenly blue is a favourite and appropriate colour in church heraldry, and the cross-surmounted staff and the pall are the special attributes of an archbishop, and altogether the "coat" is an expressive and befitting one for the purpose.

By some strange confusion, entirely opposed to the concise and even exacting spirit of armory, the shield of the See of Dublin stands charged with precisely the same devices and colours as the foregoing, but the same arrangement prevailed in England as regards York and Canterbury until the middle of the sixteenth century, and so the four chief archbishoprics of the sister islands exhibited a repetition in their arms that appears to show some want of originality.

We turn to the arms of the See of Limerick and find them recorded as,—"Azure: two keys endorsed is saltire wards upwards; in the dexter chief a crosier, and in the sinister chief a mitre, all or." Here we have the emblem of Saint Peter in the keys, with the bishop's staff and mitre ecclesiastical throughout, and dignified, if not historic or particularly interesting.

In the latter half of the seventeenth century the bishoprics of Ardfert and Aghadoe were added to the See of Limerick, but they had no arms attached to them and those given above are for the latter alone, although the triple charges might suggest otherwise.

Meath ranks first amongst the Sees of Ireland, its bishops claiming precedence over their episcopal brethren and assuming the title of "Most Reverend" as a rule. The diocese is a union of the ancient Sees of Kells, Dulick, Clonard, and others of less note. The arms are, "Sable: three mitres, two and one argent, labelled or," and it is generally conjectured that these charges refer to the triple Sees above named.

The Sees of Ireland may be said to run in triplets as a general thing, and their coats of arms are usually of modern assumption, wanting in historic interest and lacking that spice of antiquity that might be looked for in the heraldic records appertaining to such venerable buildings.

Take Down, Connor, and Dromore as an instance of the foregoing remarks. The two first were founded as early as the fifth century, and became united a thousand years after (the latter was added to them in the reign of William IV. by Act of Parliament), and yet, even in the fifteenth century, a time when heraldry was at its height, no arms were used on the seals of any of the bishops of Ireland.

The arms are, "Quarterly: first and fourth azure, two keys endorsed in saltire or, surmounted by a lamb passant in fesse argent (for Down); second and third argent, two keys endorsed in saltire proper, surmounted by an open book of the last in fesse between two crosses fitchée in pale gules" (for Dromore).

Kilmore, Elphin, and Ardagh became united as one See in the year 1841. The two latter are of very ancient origin, having been founded as early as the fifth century by St. Patrick. Their arms are now emblazoned as "Per fesse in chief argent on a cross azure, a crosier surmounted by a mitre in pale (for Kilmore). In base per pale, on dexter side sable two crosiers endorsed in saltire or, in base a lamb couchant argent (for Elphin); and on the sinister side argent a cross gules between twelve trefoils vert, and on a chief azure erect or (for Ardagh)."

We would just remind our non-heraldic readers that the trefoil vert is the shamrock of old Ireland, the other charges are of the truly ecclesiastical type.

In the Royal Irish Academy is deposited the seal of a sixteenth-century bishop of Elphin (Thomas, 1581), bearing the arms for the See as "Three mitres two and one," and is considered a work of great beauty.

The arms for Kilmore appear to have been changed by Bishop Godwin about the first quarter of the last century; they were, prior to that, "Argent: a cross gules, between twenty trefoils slipped vert."

Ware, in his "Irish Bishops," gives the arms of Ardagh with the cross azure, and only one trefoil in each quarter.

We would just say that mitres are usually depicted in coats of arms of the lofty and convexed type of the seventeenth century, being perhaps more imposing and grander in appearance than those of earlier date, but not so chaste as the simpler form that characterised the fifteenth century, and prior to that. We must not forget to mention the interesting fact of the trefoil or shamrock having been made use of by St. Patrick to illustrate the doctrine of the Trinity, which makes this national emblem all the dearer to the Irish people.

THE WALLS OF CHESTER.

SIR,—In 1849 the British Archæological Association held its sixth Congress at Chester. One of the results was the publication in the Journal of an illustrated report on the antiquities of Chester, including important portions of the walls, which were assigned to the Roman epoch. The walls were carefully examined, and a day was set apart for their especial study, with the assistance of the local Society, of which the late Rev. W. H. Massie, a sound antiquary, was secretary. It will be sufficient to glance at the names of those present to show that some of the best architectural antiquaries were present. Among them all there was not one dissentient as regards the report referred to; and, until the last two or three years, although general attention must have been directed to the walls, no one has questioned the *fiat* of the Association.

Now, however, the Geological Society has produced a member who disputes all that the Association has assented to. In his eyes the masonry of large stones without bonding-courses of tiles is Mediæval, and Late Mediæval; the ancient stones themselves were not quarried at a distance as asserted; and that they exhibit now no such difference in the lichens upon them as was obvious to the eyes of hundreds in 1849! The geologists and botanists who in 1849 assisted in the survey of the walls are now supposed to have been in error. Moreover, this new theory, if we may have read the newspapers correctly, has been recently brought before the Congress at Chester of the Royal Archæological Institute, and has received, if not a general sanction, at least a partial recognition.

Without at present analysing the arguments of Mr. Shrubsole, F.G.S., some of them may be questioned as to their validity. The old writers who have not written on the Roman character of portions of the walls may well be excused for the omission. Even the late Mr. Ormerod, accomplished as he was for general history, did not claim any special knowledge of the varieties of Roman masonry. Stukeley is not named. If he has given his opinion it would be of more value than that of the whole of the authors cited, for he had studied Roman masonry, and wherever he speaks of it he is usually very correct.

The difference in the architectural materials of the alleged Roman work from other Roman masonry found in Chester, as well as from other Roman walls, is a most unfortunate witness for the non-Roman theory. The small squared stones and bonding courses of tiles so common in Roman town walls in the south are by no means universal. While they appear at York they disappear in the important remains of *Isurium*, now Aldborough; and it would seem that they cease from this point in a northerly direction, and are wanting in all of the *castra*, as in the great wall itself.

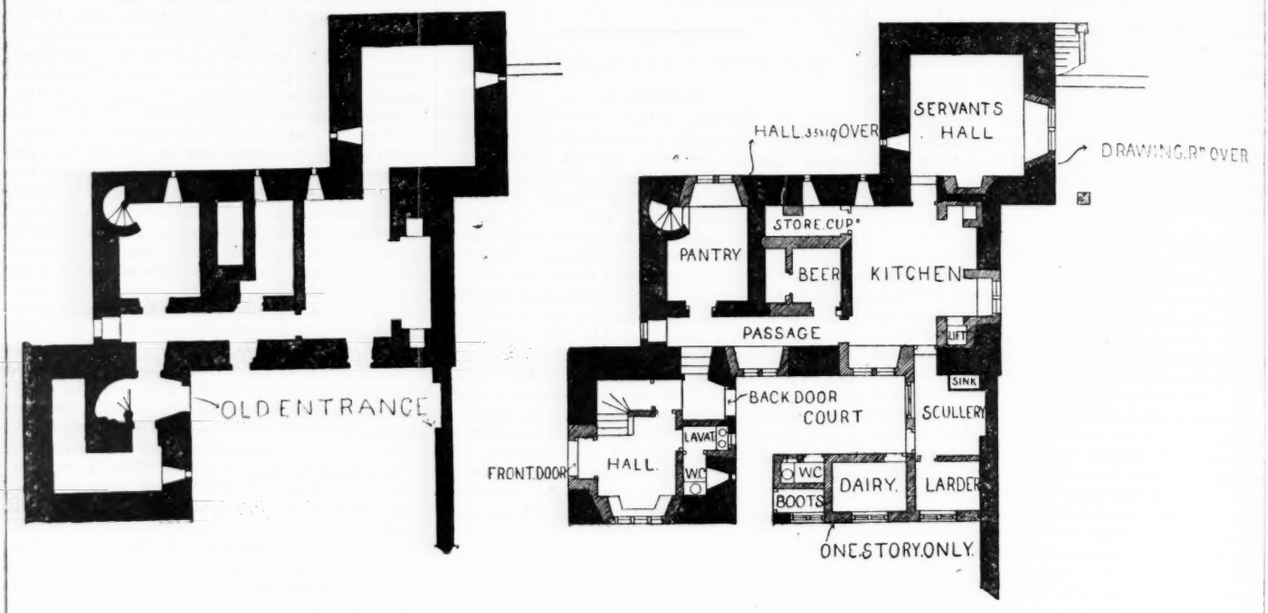
It appears that it is not denied that the cornice which surmounts a portion of the supposed Roman work is really Roman, but it is suggested that it formed part of a temple and was used for reparation, as being at hand, It is denied that Roman walls had cornices, but where are the upper portions of Roman walls to be found? There are proofs that external ornamentation was occasionally used. It does not seem to have been considered that the portion of the wall which bears this cornice flanks the core which carries a promenade. This promenade is not alluded to, nor is comparison drawn between it and the promenades upon the Roman walls of Colchester, Canterbury, and Chichester.

It is alleged that for some hundreds of yards laid open for repairs in recent times nothing was met with but loose stones and disjointed rubble. It is probable that this denoted Mediæval reparations. It would have been satisfactory if the line of the Roman circumvallation had been traced and laid open. It is not probable that it can be destroyed; though, for an immense extent, nothing of it is apparent. F. S. A.

September 4th, 1886.

THE RECENT EARTHQUAKES IN AMERICA.

MR. W. TOPLEY, F.G.S., President of the Geologists' Association, contributed to the Geological Section of the British Association meeting at Birmingham a very interesting and important paper containing "Some Notes on the recent Earthquake in the United States, including a Telegraphic Despatch from Major Powell, Director of the United States Geological Survey." The author drew attention to the earthquake disturbances which during the last few days had taken place over a very wide area of the earth's surface. On the night of August 27th there were shocks all over Greece, and in a smaller degree over all the East Mediterranean area. This earthquake wave apparently travelled from west to east. It was first felt in Malta, Calabria, and Naples, and thence it travelled eastwards as far as Alexandria. It did not appear to have been felt west of Southern Italy, probably because its westward area of propagation was there beneath the sea. Possibly it was only a coincidence, but if so, a very curious one, that the earliest important earthquake disturbances in the United States took place on Thursday, the 27th, and Friday, the 28th. There had been slight premonitory shocks for two or three days before, but the principal shock was that of Tuesday night, August 31st. This had, however, been succeeded by shocks, fortunately of less intensity, which had been felt over a still wider area. As late as Sunday night (Sept. 5) there were shocks at Charleston, South Carolina. The main shock was felt from the southern part of the New England States on the north-east to the western shores of Lake Michigan on the north-west. In the west it was recorded from St. Louis and Memphis, on the Mississippi, and from the coast of Florida in the south. Of the later shocks—and these had been very numerous—some were felt in Nevada and some in California. Examining the newspaper telegrams, Mr. Topley said it was probable that there was some error either in observation or in the telegraphing as regarded the time at New York, Springfield, and Albany. New York was 420 miles from Raleigh, and the wave was stated to have travelled in three minutes. Albany and Springfield were respectively 330 and 520 miles away, and the wave travelled to each in ten minutes. An important point in Major Powell's despatch, however, was the evidence of the rapid transmission of the main earthquake wave. Major Powell stated that it travelled over 900,000 square miles at from 25 to 65 miles per minute; but by comparing the times given in the telegram with the distances on a map, he (Mr. Topley) found that the velocity varied from 36 to 140 miles per minute. The shock originated in Central North Carolina, on Tuesday, Aug. 31, at 9.50 p.m., 75th meridian time, which is five hours in advance of Greenwich time. The time at Greenwich was therefore 2.50 a.m. on Wednesday. Although Charleston had experienced the maximum structural damage, this did not appear to have been the exact point of origin. The earliest shock was noted at Raleigh, 230 miles to the N.N.E.; here the time was 9.50. And if they took a scale of intensity with 5 at Charleston as a maximum, Raleigh was 4; Memphis (150 miles west, which the wave reached at 9.55) was also 4; Pittsburg (230 miles N.N.W.) which, the wave reached at ten o'clock, also 4. The farthest points at which Major Powell recorded the scale of intensity were Milwaukee 3, at 10.6, and Cedar Keys, in Florida, 2, at 10.5. There did not seem to be any relation between the intensity and time and the surface distance from the area of origin. This last, indeed, they would not be expected to find. They would rather have looked for rapid transmissions along certain lines or through certain rock-masses. The last important earthquake of the Eastern United States, in August, 1884, was carefully investigated by Professor Carvell Lewis. This was found to range along the eastern side of the Appallachian Mountains, nearly along the line where the old earth movements had been greatest. The exact age of the greatest movement there was well known. It was post-carboniferous, for the coal measures had been violently entombed, and coal converted into anthracite as the effect of great thrusts from the S.E. It was pre-Triassic, for the Trias lay upon the contorted and denuded edges of the older rocks. But along the same line, and parallel with it, there had been later earth movements. The Triassic beds had been faulted and invaded by basaltic dykes in pre-cretaceous time, for upon their denuded edges the cretaceous rocks were laid down. It was along the northern part of this line that the previous earthquake occurred: it was near the southern part of this line that the recent earthquake had originated. The area most affected by the recent earthquake was a vast plain of tertiary and cretaceous rocks. The older rocks underlay these unconformably but at unknown depths. It might, perhaps, be found that the transmission of the shock to distant parts had depended in part upon the range of the harder and older rocks beneath, as was very evidently the case with the East Anglian earthquake. In this earthquake the great structural damage was confined to a small area; the distant parts at which it was felt were in most cases upon or near to exposure of the Palæozoic rocks, and Birmingham was one of these distant parts. In other cases earthquakes were known to be related to lines of fault. The later telegram stated that Mr. M'Gee had been sent by Major Powell to investigate the effects of the earthquake at Charleston, and that he found the local evidence, such as the direction of the fissures, contradictory and difficult of explanation. They need not wonder, therefore, at being yet unable to understand the wider question connected with its range and transmission. Passing to the local phenomena, Major Powell's telegram stated that the earthquake had been accompanied by land-slides and crevasses, but by no sea-wave. Fissures opened in the ground, some of which ranged north and south, others east and west. From these fissures mud and sand were ejected. Several telegrams spoke of stones falling from the air, and although there was plainly much exaggeration in these accounts, it was probable that some stones were ejected far into the air, and subsequently fell to the ground. Later telegrams spoke of an unusually high tide, which did some damage over the low lands of which Sullivan Island is composed, and there was probably some connexion between this and the earthquake, as the tides were then the neap tides. Accounts varied as to the direction in which the vibratory motion of the earth travelled near Charleston, but, as was often the case near the earthquake centre, there was evidence of a twisting movement. One interesting point in connection with earthquakes was the influence they had on wells and springs, and in these respects the American earthquakes had had important results. Water now stood where none occurred before, and in certain places springs had been dried. The strangest statement, however, on this point was that the Mayor of Belloplain, Iowa, had telegraphed to Iowa for an engineer to change the course of two gigantic rivers formed by a phenomenal water-burst, which were running at the rate of twelve miles an hour, causing much destruction of property. In boring a 4-inch artesian well at a depth of 180 ft. the water had been forced several hundred feet into the air, and the stream had increased until it was 16 in. in diameter, the upward force equalling that of dynamite. The natural gas wells of Pennsylvania had been affected, and at one town (Southside, Pittsburg) the factories had been left in darkness through the natural gas supply failing. The most interesting fact, however, was that stated in the newspapers about the Excelsior Geyser in the Yellowstone, which had been quiet for four years, but which had spouted violently since August 27th. Torrents of boiling water were thrown up 300 ft. into the air. The geyser was strongly affected long before the earthquake itself was apparent in the Western States, and when only slightly premonitory shocks were apparent in the Eastern States. In some telegrams which had been published, it was stated that Mr. McGee was inclined to regard the earthquake as due to gigantic slidings of part of the earth's crust towards the sea, but that his detailed observations of the fissures near Charleston presented some difficulties in the way of this explanation. If such an exceptional explanation were the correct one, some important changes of level would be expected near the coast; but this had not been the case. It was too early yet to theorise on this side of the Atlantic, but at present the earthquake seemed best explained by referring



GROUND PLAN AS AT PRESENT. GROUND PLAN AS PROPOSED.

Glenbucket Castle.

it to some widely-acting seismic disturbance, indications of which were previously given by the geysers, and by premonitory earthquakes in South Carolina. It would probably be found, however, that its range and local intensity had been controlled by the distribution of the rock masses, or by old lines of earth movement and earth weakness.

COMPETITIONS.

Public Buildings for Darlaston.—At a meeting of the Darlaston Local Board this week (Mr. J. Harper presiding), the plans and specifications of the proposed public buildings were submitted by Mr. J. A. Cossins, of Birmingham, and approved. The main buildings and offices were estimated to cost 3,380*l.*; library, 1,410*l.*; cottage, 335*l.*, and boundary walls and gates, 190*l.*, making a total of 5,315*l.* The clerk was instructed to forward the plans to the Local Government Board for approval.

Proposed Board Schools, Smethwick.—At the monthly meeting of the School Board, held last Monday, it was reported that, in response to their advertisement to architects willing to submit designs for proposed schools to be built at "The Cape," eighteen sets had been received. Three of these were placed by the professional assessor, for the final selection of the Board, in the following order:—First, "Playground"; second, "Rex"; and third, "Experience." Upon opening the sealed envelopes it was found that the author of the successful design, "Playground," was Mr. George H. Cox, of Birmingham; of the design placed second, "Rex," Mr. Daniel Arkell, of Birmingham; and of the design placed third, "Experience," Mr. Fred. J. Gill, of Smethwick.

Illustrations.

LONDON AND COUNTY BANK (NEW PREMISES), KENSINGTON.

THIS building at Kensington Court has been erected on the site formerly occupied by Colby House, which was taken down about fifteen years ago, and formed part of the site of Kensington House, built for Mr. Albert Grant, which has since been removed to make room for other buildings.

The ground-floor, with the basement under, is wholly devoted to the business of the bank; the upper floors are occupied as the manager's residence, with separate private entrance from the street under the adjoining house.

The elevation is built with red Mansfield stone, and Farnham red bricks, in narrow courses. The ground-floor is in part constructed with brick arches, and in part with Portland cement concrete and iron girders. The floor of the banking-room is in part laid with marble mosaic, and in part with yellow deal wood blocks. The ceiling is formed of fibrous plaster, fixed to coke breeze and Portland cement concrete floors, between iron girders. The walls are lined with an American walnut moulded dado, with Belgian granite surbase moulding and plinth, and an under dado of inlaid wood parquetry. The fittings throughout have been made to the architect's designs to harmonise with the building.

The building was designed by Mr. Alfred Williams, and carried out under his supervision by Messrs. T. Rider & Son. The carving was executed by Messrs. W. Seale & Son. Mr. Mackenzie acted as clerk of the works.

The drawing from which the illustration is taken was exhibited at the Royal Academy.

GLENBUCKET CASTLE, ABERDEENSHIRE.

GLENBUCKET CASTLE, about twenty miles from Alford, in Aberdeenshire, is a good example of the smaller Scottish castle of the seventeenth century. It stands on a wooded platform on the hillside, above the beautiful valley of the Don, on a site chosen as usual with consummate feeling for effect, though that is rather a result than a foreseen intention realised. The castle was built at the end of the sixteenth century by a certain Adam Gordon, whose inscription still remains on the lintel over the old entrance, "Adam Gordon and Helen Carnegie. Nought remains on earth bot fame." After various fortunes the castle was finally abandoned about fifty years ago, and the whole building has been allowed to crumble away ever since; all that now remains are the extremely massive walls, with a few fragments of the original ashlar work sufficient to show the character of the whole.

The ground-floor seems originally to have been used for kitchen and offices, and is very rudely vaulted. A large newel staircase communicated with the first floor, and a smaller one from the offices, both opening into what would have been a hall, beyond which, say, was the dining-room, and a retiring-room in the wing beyond. This, however, is merely a conjectural account, for, in fact, the uses to which the first floor was put must have varied according to the number of the master's retainers, and the circumstances of his time. Two more newel staircases communicate between the first floor and the bedrooms, but the latter have disappeared, leaving no further evidence than the holes for the joists, and one or two mouldering wall-plates. Only the corbellings of the original corner turrets remain. The few mouldings left are seventeenth century in section, and the whole building shows the transition from the castle to the living-house; but the castle still predominates, for the house is so arranged that the inmates could retire from part to part, shutting themselves off as they went. Scotland was always about 100 years behind England in civilisation, and its architecture never emerged from a certain uncouthness and crudeness of style. While our Jacobean architects were making windows so large that a man could not know "where to be at to be out of the sun and wind," here was Adam Gordon making his narrow windows, and all with shot-holes under the sills.

The castle, with the Glenbucket Estate, recently came into the hands of a purchaser who proposed transforming the castle into a habitable house. The old hall and dining-room were to be made into one large dining-hall, with a screen at the staircase end. The flight of steps shown on the drawing was to serve as access to the lawn-tennis court and garden, the front door necessitating this addition by its unavoidable distance from the garden side. The work has not been executed owing to the death of the owner.

The drawing was exhibited at the Royal Academy this year.

REGINALD T. BLOMFIELD.

ASKE'S SCHOOLS FOR GIRLS, HATCHAM.

THIS school, to be erected for 400 pupils and capable of extension, will stand on the southern portion of about two acres of land, on the south side of New Cross-road, and nearly opposite the railway station.

The ground-floor will contain a dining-hall below the examination-hall, ample arrangements for cloak-rooms and lavatories, with kitchen and servants' offices, and covered playground with gymnasium. The principal floor is given on the sketch.

The first floor will contain several class-rooms, accommodation for the assistant teachers, a spacious studio, and a lecture-room, with attached laboratory for pupils.

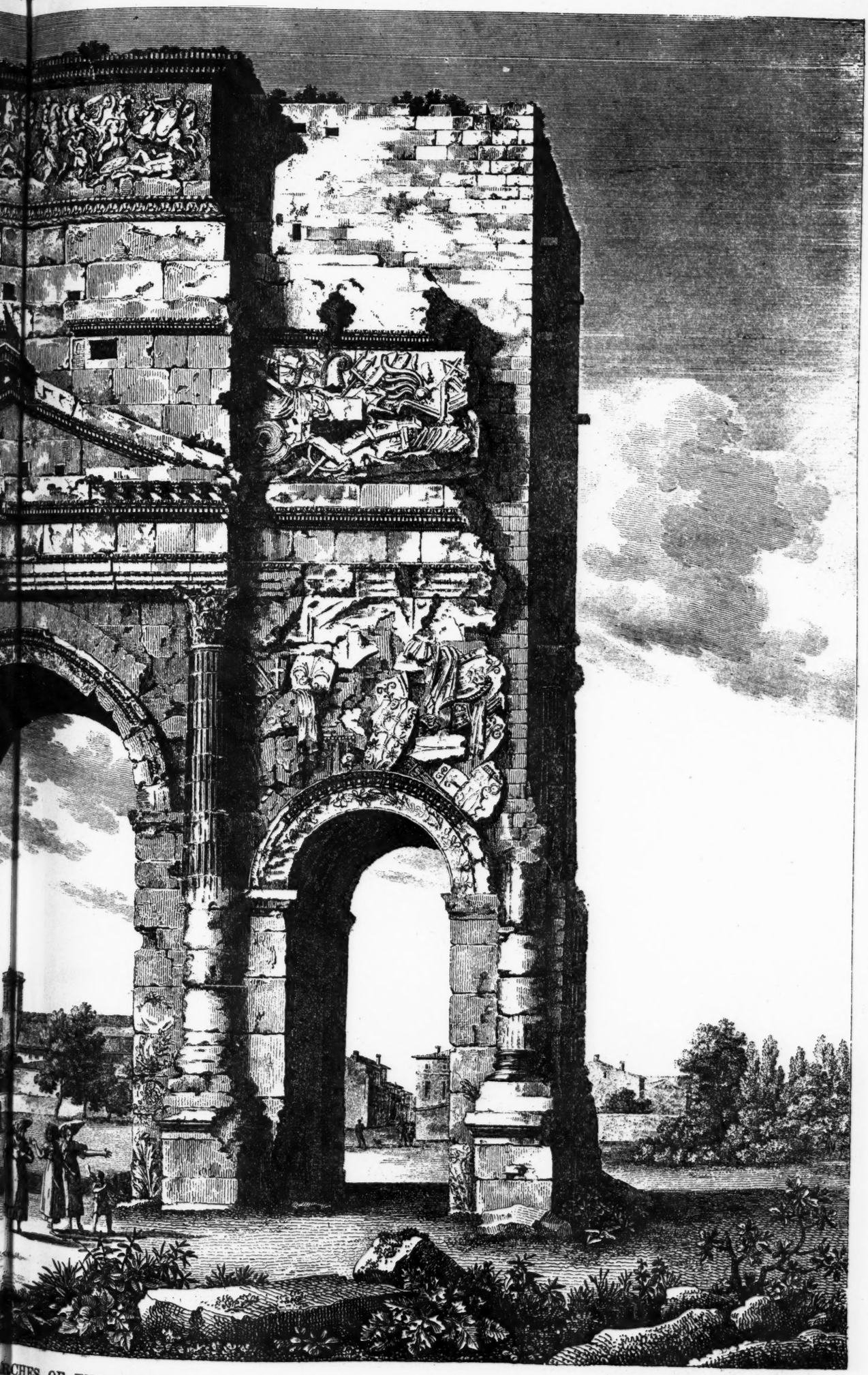
In the roof are servants' rooms, and other accommodation, as well as a rarifying chamber for ventilation. The materials proposed are red brick facings, with York-stone dressings and plain-tile roofs. The whole of the building will be warmed by warm water in coils, and the total estimated cost, inclusive of the land, is 23,500*l.* The architect is Mr. Henry Stock.

The drawing was exhibited at the Royal Academy this year.

C. F. Kell Photo-Lith

THE TRIUMPHAL ARCH

THE ARCH AT ORAN



RCHES OF THE ROMANS.

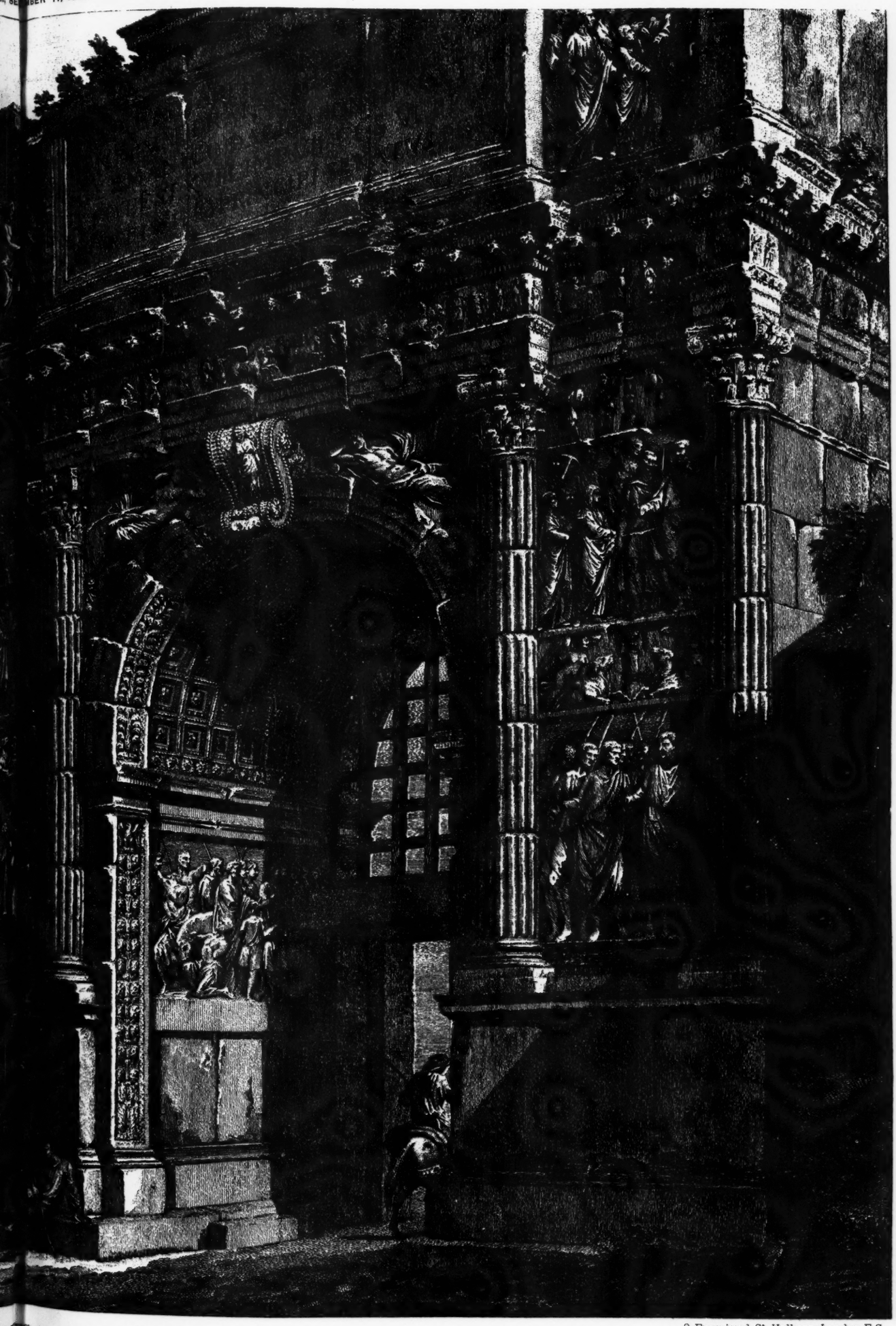
From an Engraving by Baltard.

8 Castle St Holborn, London, E.C.

C. F. Kell Photo-Lith & Printer.

THE TRIUMPHAL ARCHES

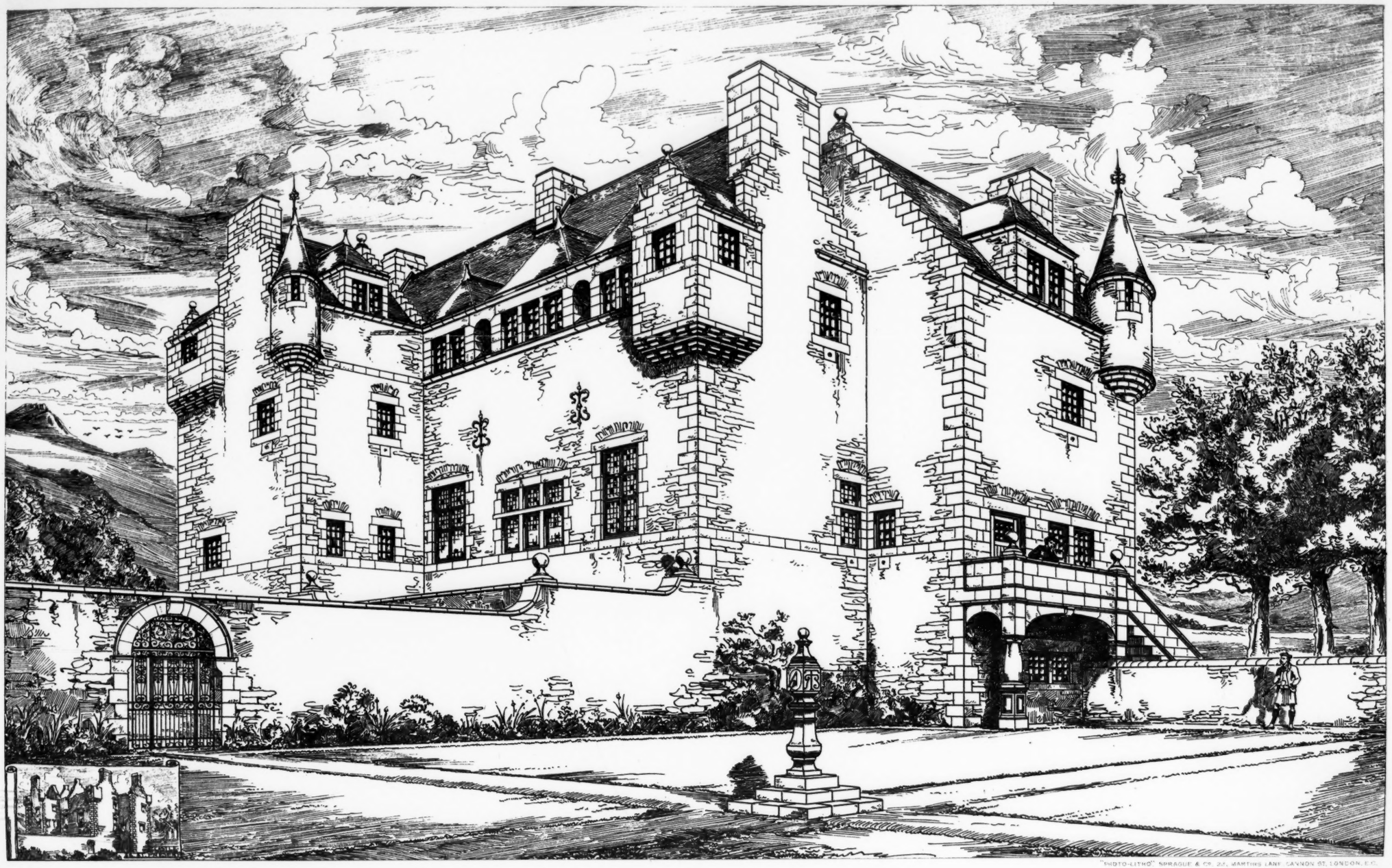
ARCH OF TRAJAN AT BENEVENTO



ROES OF THE ROMANS.

From an Engraving by Cunego.

8, Furnival St Holborn, London, E.C.



"PHOTO-LITHO" SPRAGUE & CO. 22, MARTINS LANE CANNON ST. LONDON, E.C.

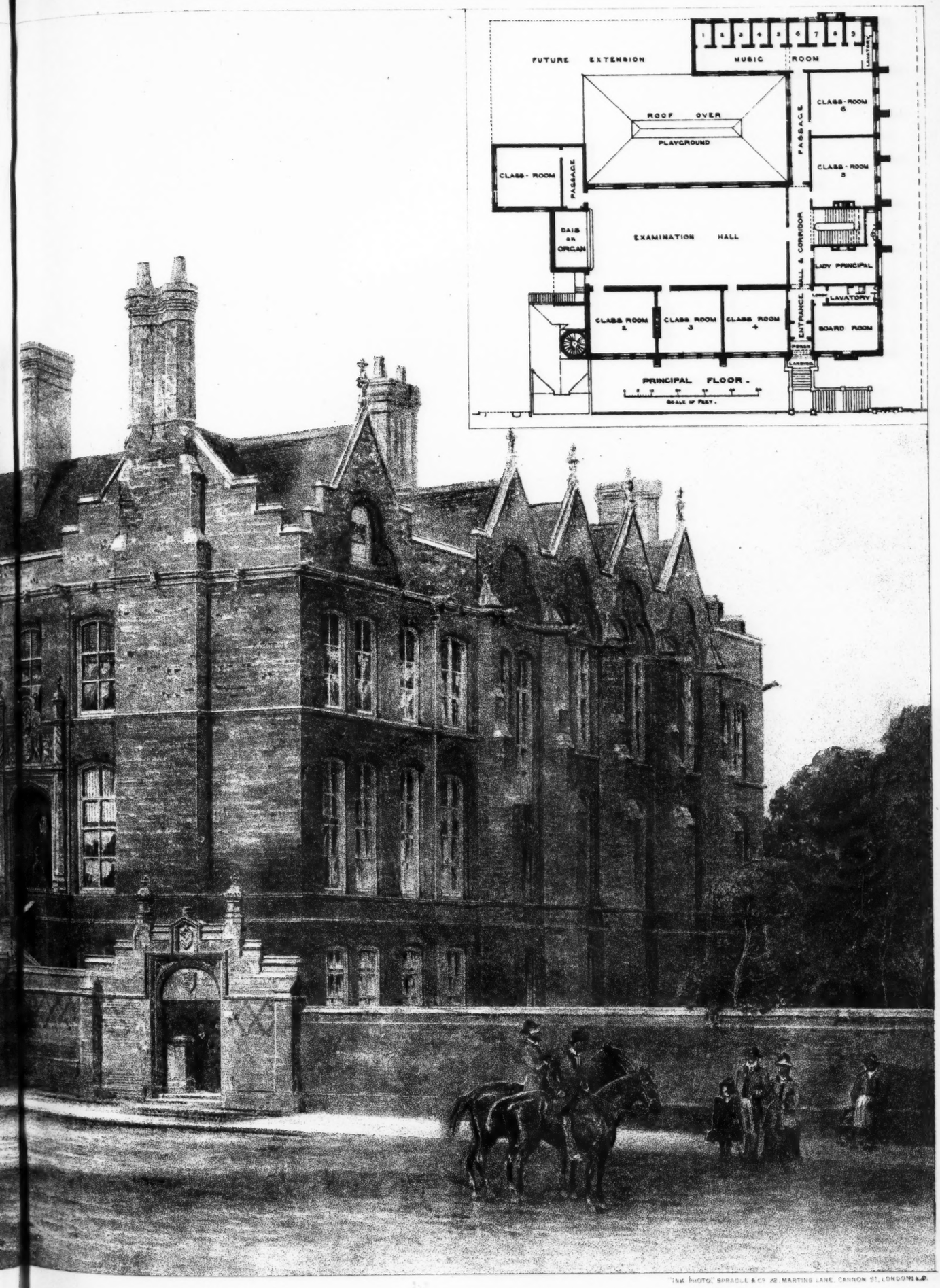
PROPOSED RESTORATION OF GLENBUCKET CASTLE, ABERDEENSHIRE.

MR. REGINALD T. BLOMFIELD, M.A., ARCHITECT.

"PHOTO-LITHO" SPRAGUE & Co. 22, MARTINS LANE, CANNON ST. LONDON, E.C.

LONDON AND COUNTY BANK, KENSINGTON.—Mr. Alfred Williams, Architect.

THE NEW HATCHAM SCHOOL FOR GIRLS, NEW CROSS



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S, N... CROSS.—Mr. Henry Stock, F.R.I.B.A,. Architect.

ART QUESTIONS AT THE BRITISH ASSOCIATION MEETING.

IN the Anthropological Section of the Birmingham Congress of the British Association for the Advancement of Science, Professor Boyd Dawkins, M.A., F.R.S., F.S.A., read a paper on "The Celtic and Germanic Designs on Runic Crosses." He said it was very generally assumed by archæologists that the early Irish MSS., the Book of Kells, and the illuminated gospels of St. Cuthbert and St. Chad, were of pure Irish art, and that consequently the interlacing "rope" or "basket" work pattern was distinctly Irish and Celtic. It was, however, an assumption which might be readily disposed of by an appeal to the designs on ornaments and monuments in the British Isles and in France, Scandinavia, and Germany. These he considered under two heads—viz., the scroll, spiral, and flamboyant work, consisting of graceful combinations of curves; and, secondly, the interlacing work, more or less square and angular, the "rope" or "basket." The first of these two styles first appeared in the British Isles, Scandinavia, France, and Germany in infinitely remote prehistoric times, in the Bronze Age, and subsequently became more and more elaborate in the prehistoric Iron Age, constituting the "late Celtic art" of Mr. Franks. This art was probably ultimately derived from the centres of civilisation in Southern Europe, principally Greek and Etruscan, and had been proved to have been introduced into France from Italy. From its prevalence among the Celts of the British Isles and of France, it was justly termed Celtic. The interlacing pattern of this, too, was conspicuous by its absence from Irish art until the days of early Irish Christianity. It might be traced far and wide over Europe, and among nations who owed nothing to Irish art. From certain facts, it might be concluded that it was distinctly Germanic and not Celtic, and still less "pure Irish." The assimilation of the Celtic, graceful, spiral, and flamboyant, with the German design, not only in the early Irish manuscripts, but in Irish chalices and ornaments, might readily be accounted for by the influence of the Germanic tribes (including Scandinavians), not only in Ireland in the eighth and following centuries, but in those parts of Europe traversed by the Irish missionary. The conclusion to which he arrived was that the Irish illuminated manuscripts could not be taken as the tests of pure Irish, or even of Celtic art, but that a large part of the ornament was due to contact with Germanic art.

The Chemical Section met on Saturday in the Lecture Theatre of Mason College, when Professor Hartley read a paper on "The Fading of Water Colours." Recently, he said, considerable correspondence has taken place in the columns of the *Times* in connexion with this subject, and an article has appeared in the *Nineteenth Century Magazine*. There have been two ideas brought forward,—one being that water-colour drawings fade on keeping, while others have contended that the tints increase in depth on keeping for a length of time. Hence, on the one hand it has been recommended to keep water-colour drawings in the light, while others have suggested that darkness is preferable. The colours used are of two kinds, mineral and organic. Mineral colours are generally unalterable, except in special cases, such as lead. The tendency is for red light to act as an oxidising agent on such colours, while violet light exerts a reducing action. But in the case of organic colouring matters oxidation is promoted by light from either end of the spectrum. Acidity in any form is a great cause of the deterioration in water colours. The chief sources of acidity are the impurities in the atmosphere in presence of moisture, imperfectly prepared colours, and the acidity of the paper. The paper is always itself slightly acid, and the use of size or gum is a source of acidity, while the burning of coal and of gas in towns produces a sensible amount of sulphurous acid in the atmosphere. The author has carefully examined the effect of acids, of exposure to sunlight, of hydrogen peroxide, and of sulphurous acid in the case of sixteen common water-colours. As a result, he concludes that the character of the colours examined is very creditable to the manufacturer. Lakes are very permanent in pure air; while cases are known where indigo has remained unchanged for upwards of 1,800 years. Indigo is, however, liable to be attacked by acids. Generally the effect of chemical agents upon water-colours is what might have been expected from their chemical composition. Thus, yellows containing cadmium sulphide are bleached by oxidising agents. In some few cases, however, unexpected results were obtained. Ultramarine is very readily affected by dilute acids; no preparation of lead should be used as a pigment, either for oil or water-colour drawing. It is shown that many water-colour drawings have been exposed to light for fifty years or more in properly-arranged galleries, without appreciable deterioration. The tendency is to produce apparently darker tints, owing to the lighter tints being most liable to fade, while the brown colour developed in the paper itself tends to produce a similar effect. To preserve delicate sunlight effects the drawings should be kept in rooms imperfectly illuminated, and preferably with blinds transmitting a yellow or brown light. They should be carefully protected from the effects of an impure atmosphere, while paste or gum should not be used in affixing them. A slight wash of borax on the paper destroys its acid reaction, and makes the colours fix readily on the fibres. A small quantity of borax might be used in the water employed for mixing the colours. For illuminating galleries incandescent lamps are to be preferred to lighting by the electric arc, as the latter may be regarded as a sure means of destruction of the colours.

Mr. Crookes, after referring to the value of the paper to which the meeting had just listened, mentioned that a committee had been appointed by the Science and Art Department to work with artists and chemists, and from the labours of this committee much benefit might be anticipated.

HEALTH QUESTIONS AT THE BRITISH ASSOCIATION MEETING.

IN the Chemical Section of the British Association meeting at Birmingham, Professor Carnelly read a paper on "The Air of Dwellings and Schools, and its Relation to Disease." The paper dealt with an elaborate series of experiments undertaken by Dr. Carnelly at Perth and Dundee, in connexion with the sanitary and school authorities, the object being to determine the relations between the composition of the air and the death-rate in houses and schools; and also the effect of various systems of ventilation. For this purpose the carbon dioxide, organic matter, and micro-organisms were determined, both in the outside air and in the room to be examined. In the air of the towns of Perth and Dundee a distinct increase of impurities could be detected in close parts of the towns as compared with the open spaces. In examining the dwelling-houses the experimenters had authority from the sanitary officers, and visited bed-rooms and similar places during all parts of the day or night, while actually occupied by the inhabitants. Houses are divided in the tables into one, two, and four roomed dwellings, and mention was made of some cases in single-roomed dwellings in which eight persons were found sleeping in a single bed, and in many cases no bed was found in the dwelling at all. The impurities in the air of such houses were naturally much greater than in those of a better class, and by a careful comparison of the chemical composition of the air with the death-rates from various causes in the various classes of houses it was shown that on an average the length of life in a one-roomed house was only twenty years, whilst that in better class houses is forty years. Hence a person born and living in a one-roomed house has a chance of living only half as long as those born and living in a four-roomed house. This depends naturally to a considerable extent on other causes than impure air supply. Some irregularity was observed in the cases of consumption, scarlet fever, and diphtheria, which is, however, quite capable of explanation. The influence of cubic space on the purity of the air in dwelling-rooms was somewhat unexpected, the best results being noticed when 1,000 cubic feet was allowed to each person. With larger rooms, owing to stagnation of the air, the result is not so good. Sixty-eight schools in Dundee were examined; of these twenty-six were mechanically ventilated, while the others were ventilated by means of windows. The advantages were distinctly in favour of mechanical ventilation, the micro-organism being one-seventh and the carbon dioxide one-half of that in the other schools. Mechanical ventilation not only materially improves the quality of the air, but also has less influence in unduly reducing its temperature. On comparing together boys' and girls' schools the air is almost invariably less pure in boys' schools. The amount of carbon dioxide does not afford any indication of the amount of organic matter or micro-organism, except by taking the mean of a large number of experiments. Cleanliness of person has a comparatively small influence on the number of micro-organisms, but cleanliness of dwelling-rooms and schools has a most important effect. Hence the air of new schools is distinctly better than that of the older buildings. In conclusion, the author suggested that in many cases the evil said to be due to over-pressure in schools was doubtless due to imperfect ventilation, and that if Dundee may be fairly regarded as an example of a British town, then certainly our schools are most imperfectly ventilated; and that for improvement in this respect the advantage of mechanical ventilation should be strongly insisted upon.

Dr. Tidy gave a brief account of some elaborate experiments performed, in conjunction with Mr. Crookes and Dr. Odling, on "The Action of Drinking Water on Lead." The authors had examined the action of the waters of a large number of English towns on lead used for service-pipes, &c. It was found that the liability of soft water to act permanently on lead was not, as commonly supposed, proportionate to its softness. Again, the capability of soft water to act permanently on the lead services was not necessarily relative to the extent of its activity on clean and new lead. Thus, one supply, which on exposure to clean sheet lead for twenty-four hours was found to take up 1·17 grain per gallon of lead, was quite without action on the lead services; whereas other supplies which, after the same length of exposure to clean sheet lead, were found to have taken up only 0·78 and 0·71 grain per gallon of lead, were among the examples acting most strongly on the lead services. One curious fact, which had not up to this time been suspected, was clearly shown by the analyses,—namely, the relatively large proportion of silica in those waters where no lead was found in the supplies as compared with its amount in those waters in which lead was found. Thus, in the former series, the silica in the water averaged 0·53 grain per gallon, whilst in the latter it only averaged 0·21 grain, or constituted about two-fifths of that present in the former case. Moreover, in no single instance was a water with more than 0·5 grain per gallon of silica found to exert a solvent action on the services; and in no action was a water with less than 0·3 grain per gallon of silica found to be without such solvent action. This was the first link in a chain of evidence which led the authors to think that the true explanation of the circumstance why certain soft waters act on lead for a short period only was to be found in the larger proportion of dissolved silica present in these waters, and the consequent formation of an insoluble lead silicate as a coating in the pipe. A full account was given of the series of experiments, and the question was asked, What is the maximum quantity of lead permissible in a water used as a supply for potable purposes? So far as the authors knew, there was an absence of any direct evidence to show that water containing not more than 1-20th of a grain of lead per gallon has been productive of harmful effects. It is indisputable that considerable quantities of lead may be taken into the system by very many people without any injurious effects whatsoever manifesting themselves. In connection with this it is noticeable that in at least three towns, not including Huddersfield, of which the water supply came under examination, although the supplies delivered through the lead services would seem to contain habitually an appreciable proportion of dissolved lead, ranging from 0·05 to 0·50 grain per gallon, yet cases of reported or alleged lead-poisoning were of very rare occurrence in these towns, and for the most part not of a well-demonstrated character. Without doubt cases may and do occur which are unrecognised or are not attributed to their true source, because of their slow and insidious character. It was pointed out that if a lead water, containing 0·5 grain of lead per gallon, be used for making tea, the quantity of lead in the tea infusion may be reduced to less than 1-100th part of that in the original water, the

chief part of the lead being found in the tea-leaves; and that much the same abstraction, though to a somewhat less extent, occurs in the case of coffee. The authors considered it impracticable, even were it advisable, which was doubtful, to replace the lead pipes by iron pipes or pipes of tinned lead. Lead pipes possessed the advantage of cheapness, durability, flexibility, and the ease with which they could be wrought and repaired. The results of the experiments made both on a large and small scale warranted the authors of the paper in recommending with confidence the systematic and continuous filtration of the water, recourse being had to such modifications of the ordinary filter-bed as would ensure the efficient silication of the water. Efficient silication would, in their belief, minimise to the utmost, and practically altogether prevent, the action of the water on the lead surfaces, thereby effecting a real hygienic improvement, and allaying the justifiable apprehensions of consumers as to the possibility even of injury resulting to them from the lead-dissolving character of the water supply. Such filtration would, moreover, in a special manner improve the brightness and colour of the water, and would lessen the quantity of organic matter held in solution.

Mr. Durham asked if the silica was deposited when the lead dissolved.

Dr. Tidy said this point was at present not determined. The silica present had been estimated in the ordinary way.

Mr. A. H. Allen (Analyst to the Borough of Sheffield) said he had taken part in the work connected with the analysis of the water of Huddersfield, to which the author had referred, and he wished to congratulate the author on obtaining definite results. The idea that the amount of lead depended on the hardness of the water was not now accepted by analysts of experience, but was only to be found in our text-books. He thought that the work of Mr. Jarmain showed that other acids than silicic might have an effect upon lead. In Sheffield they were now suffering from lead-poisoning in some parts of the town, and he was delighted to find that the authors had been successful in providing a remedy for the difficulty of which they had to complain.

Dr. Leeds suggested that organic matter present in soft water had a considerable influence on the power of dissolving lead.

Dr. Odling did not like to put altogether aside the question of hardness and softness. Exceptionally they knew hard water did act upon lead, but soft water generally did so. The results were also much affected by the amount of carbonic acid present, and the mechanical condition of the metal itself. When it was first proposed to bring Loch Katrine water to Glasgow, there was very much difference of opinion among chemists as to its probable influence on lead pipes. Some chemists even went so far to say that this water acted upon lead more than any water they had ever examined. As a matter of fact, however, Glasgow was not troubled in this way, the reason being that soft water often ceases to act upon lead after a very few days. In some cases, however, this action was persistent. Their experiments proved that in these cases the addition of silica arrested this action, half a grain per gallon being capable of producing this effect.

Mr. Jarmain expressed an opinion, based upon his experiments with Huddersfield water, that the presence of any acid was capable of increasing the action upon lead.

Mr. McGregor suggested that the pipes might be protected, before being laid, by the use of a water which had only a temporary action. This would give a protecting coat on the inside.

Professor McLeod asked about the effect of water containing different amounts of carbon dioxide. He suggested that such solutions might contain a little silica dissolved from the glass vessels in which the solution was prepared.

Dr. Tidy, in reply, stated that the water which was most acid at Huddersfield was not supplied to the complainant in the action. The effect observed was the same whether the water was acid or not.

Dr. Odling, F.R.S., then gave a brief account of his researches on the "Micro-organisms in Drinking Water." It had, he said, often been alleged that zymotic diseases are largely caused by drinking water, but on examination of a large number of the cases cited, it has been found that the evidence produced is altogether insufficient to support such a conclusion. Still, the speaker was of opinion that there were cases which had been carefully tested, and which proved beyond a doubt that water was capable of propagating zymotic diseases. But they also had the circumstance that large communities might drink badly-polluted water, and so be subject to many sources of infection without any appreciable effect being observed on the general health. Of this we have an example in the case of London, some twenty years ago, when its inhabitants were largely supplied with Thames water, into which many large towns, such as Windsor and Banbury, emptied their sewage, without any purification whatever. Yet it could not be shown that the persons who used such water suffered more severely from cholera or zymotic disease than other portions of the community. In what he had stated they had apparently two entirely opposite and contradictory statements. But he thought the explanation was found in some recent experiments which he had performed, and which showed that the vitality of bacilli was very small when present in water. He had employed the bacilli of splenic fever as an example which could be readily examined. This had been introduced into sterilised water, and the influence of the liquid determined by admixture with nutritive solutions. When the bacilli had been present in the water for not more than six hours propagation always ensued, but after twelve to eighteen hours the water was without action on the test solution. A very similar effect had been obtained when experimenting with various natural waters, and he believed this result afforded the explanation to the apparent difficulty to which he had drawn attention. Another fact to be borne in mind was that a single spore appeared to be incapable of propagating disease. An illustration of this was met with in the process of vaccination, where it was necessary to make several punctures, and to introduce a sensible quantity of lymph. The loss of vitality of the bacilli after being some hours in water, and the fact that a number of spores were necessary to carry disease, he believed to be at the root of the difficulties to which he had referred.

Dr. Tidy stated that an examination of the death-rates in the various parts of London for the last ten years showed that the deaths from zymotic diseases were much greater in the case of those who were supplied with deep well water from the chalk than in the case of those who were supplied with water from the river.

Two papers on sewage disposal were read before the Mechanical Science Section. The first, on the automatic pumping of sewage by high-pressure water, was by Mr. Baldwin Latham, M. Inst. C.E. The author shortly described a method of transmitting power from a central point, and using such power as a convenient mode for automatically raising sewage in any district. Two machines were placed vertically in one chamber, and so arranged by means of floats that when one machine was overpowered by the volume of sewage, the second machine would come into action. By this method, he stated, power could be transmitted more economically than by any other mode at present in use.

The second paper was on the Birmingham District Drainage Board, and was contributed by Mr. W. S. Till. Mr. Till stated that the Board was formed in 1877 by Provisional Order under the powers of the Public Health Act, 1875, the object being to unite certain of the various local authorities of Birmingham and its immediate neighbourhood for the purpose of sewage disposal, and to afford facilities to such authorities for the interception of sewage from the streams of the district and the conveyance of such sewage to outfall works. The district around Birmingham is situated near the summit of the watershed of the Trent, being drained by the river Tame, which, with its tributaries, discharges into the Trent, about midway between Burton and Tamworth. The natural watercourses being very small, great anxiety was felt by the various local authorities as to their pollution by the dense population along their banks; and this, together with the cost and difficulty of each individual authority establishing its own outfall works and conveying its sewage thereto, led to the formation of the drainage district. This district, which comprises the borough of Birmingham and ten other urban or rural sanitary districts, has an area of 47,275 acres, with a population of upwards of 600,000, and is governed by a board of twenty-four members, selected by the various constituent authorities. In accordance with the Provisional Order, the Board acquired from the Corporation of Birmingham the sewage works at Saltley, consisting of 262 acres of land, and the extensive system of tanks, plant, stock, &c.; and these works being situated at the natural outlet for about nine-tenths of the total population of the drainage district, arrangements were commenced as soon as the Drainage Board came into existence for placing the districts of the various constituent authorities in communication with the outfall works so acquired. Accordingly, in some instances, the existing sewers of one authority were allowed to be used by another authority on payment of an annual sum, and, in other cases, extensive systems of new intercepting sewers were constructed, so that at the present time nearly the whole of the populated areas of the drainage district are connected with the outfall works. Pending the completion of these intercepting arrangements the Board had been proceeding with the extension of the outfall works, having acquired such quantity of additional land adjacent to and eastwards of the Saltley farm as to raise the total area of farm land to 1,227 acres. This land has been drained, levelled, and laid out for irrigation, and is of such an altitude that the whole of it, except about sixty acres, can be irrigated by gravitation. Extensive farm buildings have also been erected, and those originally existing improved. The principle of purification now adopted is partial precipitation in tanks, with subsequent irrigation. The volume of dry-weather sewage is about 16,000,000 gallons per day; about thirteen tons of lime are used per day for neutralising the acids contained in the sewage and assisting precipitation; and last year 135,476 cubic yards of mud were arrested in the tanks and dug into the land. The Board itself farms the land. Mangolds, swedes, kohl rabi, rye grass, and market garden produce are the principal crops grown under sewage. The production and sale of milk is also an important item of the farming operations.

The section adjourned for the purpose of visiting the sewage farm. Vehicles were provided for the purpose, and the party on reaching Tyburn Farm was entertained at luncheon by Alderman Avery. In the course of their inspection of the farm they were first shown the liming station, where lime for neutralising the acids and assisting precipitation is mixed with the sewage. The latter, having passed through a series of tanks wherein the grosser impurities are arrested, is carried by conduits to various parts of the farm, and is distributed over the land, the effluent being conveyed by subsoil drains into the river. The scheme was discussed by the members, and made the subject of much favourable comment.

"London Reconstruction and Re-housing as a Business Enterprise" was the subject of a paper read by Mr. William Westgarth in the Section devoted to Economic Science and Statistics. He introduced his subject by alluding to the heritage of debt usually left to the ratepayers, as the result hitherto of urban sanitation and reconstruction undertaken by the municipality. He proposed to reconstruct the ill-conditioned areas of central London as a self-remunerative business; and he explained how the recoupment of cost was to be effected by what he called the "natural increment" of site value (using that term in place of the invidiously so-called "unearned increment" of economists), besides the increase of value due to the improvement itself. He meant to do this by means of a Joint Stock Company or Trust, and there were certain facilities and privileges which the Trust would reasonably ask of the Government, in return for the sanitation and reconstruction the Trust contemplated, all of it cost free to the ratepayers. He then explained natural increment as simply the result of the increase of population, commerce, and wealth upon and around sites or areas which were themselves inextensible. It was the feature in common of all progressive countries, and especially of their larger towns, and had been markedly the feature of London, and of central London particularly, whose natural increment during the last thirty years might have availed for an entire systematic reconstruction. Such a considerable term of years must be dealt with, because natural increment, like other things commercial, is subject to sub-waves of excitement and depression,

as illustrated by the excitement and site-value increase between 1870 and 1878, as compared with the eight subsequent years of depression or comparative depression. He went on to allude to the great Paris reconstruction, where, by the immediate re-sale in fee simple of the expropriations, after clearing, realignment, &c., all the natural increment had been abandoned to the private investors and speculators, leaving thereby an enormous debt upon the city. But so enormous also had been the subsequent value-increase, that he was warranted in saying that Paris could have been successfully reconstructed as a private enterprise by holding for an adequate term to the sites, much in the way he now proposed for London. Having stated principles, the author then passed to details. In the first place he must be helped by a special Act of Parliament, to enable the Government to deal with and authorise a Trust when of adequate resource and responsibility. Without this special facility no body of responsible and busy men would attempt such a work, and this Act, while they were about it, he should make general and not merely for London, so that public-spirited persons elsewhere might institute similar Trusts. The proposed Trust would have ten millions of capital to start with; but this could take the convenient form of a small paid-up, and a large liability, capital. The advantage of this form, as much successful experience had shown, was that, while a dividend might be large and satisfactory as compared with the paid capital, it yet weighted the concern with only a small charge as upon the whole capital. This plan answered well where there was confidence in the undertaking. And responsible shareholding would still be secured by making the shares of exceptionally large amount. But this form of the capital would involve large borrowing from the public, and in order to do this cheaply (for it was everything to tide over, at lowest cost, the considerable interval till natural increment became effective), the Trust would claim a contingent rating liability as additional security for its loan issues. The ratepayers, protected by the Trust's capital and judicious business procedure, would have only a nominal liability. Under this concession the Trust's dividends must be by agreement with the Government. Then followed conditions or limits to the full powers of action given to the Trust. No step could be taken without approval, or in face of the veto of Government or municipality. Hostility on their part was not to be even dreamed of in this beneficial work. The Board of Management would include a representative of the Government, of the Corporation, and of the Board of Works. A further condition would be that, in its possibly large expropriations, the Trust should, as far as practicable, offer siteholders, on fair agency terms, the option of co-operation instead of expropriation. This seems only fair, where the object is not such disturbing expropriation, but improvement. Finally, Mr. Westgarth, in commending his project to favourable attention, said that he was ambitious to invite the help of the very highest London names in forming his Board, and thus alike to inspire public confidence in an enterprise somewhat novel in character, and to do full justice to a project which contained all the possibilities of the grandest and most beneficent of business enterprises.

THE REGULATION OF WAGES.

THE report of the committee appointed by the British Association to consider the question of the regulation of wages by means of sliding scales was read by Professor Munro at the Birmingham meeting. This stated that only a few replies had been received to the circular issued by the committee to associations of coal-owners and miners, asking for detailed answers on certain aspects of the sliding scales. They were, however, very valuable, as they clearly showed that each scale had special characteristics of its own, and that no comparison could be instituted between the various scales without taking into account the exact circumstances under which each scale was framed. In some districts special allowances in the way of a free house and coal were made to miners, whilst in other districts no such allowances were made. The replies tended to show that in the last-mentioned districts the non-allowance of a free house and coal was taken into account when the standard rates of wages were fixed, and thus an apparent inequality in two scales was definitely explained. The original standards seemed all to have been fixed on a common principle, viz., to take the price of coal then realised and the wages then paid as representing a fair and equitable division of the produce between the mine-owner and the miner, and as giving as high a wage as the industry could then afford. Some districts adopted the price of all coal sold, other districts the price of all coal raised, as the standard price. The real economic difficulty in framing the scale began when it had to be determined what proportion of a rise or fall in prices should go to the men and what to the mine-owners. Both parties contemplated a rise rather than a fall in prices, and the changed conditions of the coal and iron industry had exposed the scales to some opposition, but their wise revision from time to time had maintained their influence with both masters and men. The difficulties in the way of basing a scale, not merely on the selling-price, but on variable elements in the cost of production, were universally admitted, but there was little doubt that where one trade depended on another, variations in the cost of the raw material would require to be taken into account in fixing wages. The coal trade had escaped the difficulty owing to royalties having been fixed for a considerable period of time. But were a sliding-scale adopted in other trades it might not be successful unless the price of raw materials were one of the elements on which the division of the produce were to depend. Further information on this important point was very desirable, and it was recommended that the committee be re-appointed.

ENGINEERING QUESTIONS DISCUSSED AT BIRMINGHAM.

IN the Mechanical Science Section of the British Association Meeting at Birmingham, Mr. W. Shelford, C.E., and Mr. A. H. Shield, C.E., contributed a paper upon "Some Points for the Consideration of English Engineers with Reference to the Design of Girder Bridges." The writers affirmed that a general comparison of English, German, and American bridges, with especial reference to the class of work adapted to newly-developed countries, afforded sufficient grounds for the examination of the English practice. This examination was limited in the paper to bridges of moderate span, which, on account of their number, were of greater economic importance. The results of a comparison of typical designs for bridges of 140 ft. span were given, and it was stated that the difference between the weight of good designs of the same depth was comparatively small, while the principle that economy was obtained by increasing the depth obtained to an extent which, if recognised in theory by English engineers, had not hitherto found general expression in their practice. This was, however, partly due to external conditions, and it did not appear that there were essential national errors or prejudices in design which were likely to place English engineers at a disadvantage in colonial work. The difference between the position of the designer in America and England was investigated, with the result that, while the advantages of the English system in the interest of security were admitted, it was found to be attended with disadvantages with respect to economy, for which the publication of details of the comparative cost of different methods of construction and the adoption of standard sections for rolled iron were suggested as partial remedies. The scientific and commercial interests of engineering called for the abolition of the Board of Trade rules which determined fixed limits of working stress unless they could be brought into conformity with modern knowledge of the properties of materials and the laws of construction. The objections to their abolition, although it would open the investigation of the subject to private enterprise, were pointed out, and the construction of new rules was suggested; such rules, while preserving the freedom of the engineer in the choice of design and material, and leaving to him the estimation of all those effects of loading a structure which were capable of determination by known methods, should determine for his guidance by coefficients of safety the provision to be made separately for each of the effects which were usually understood to be covered by an arbitrary factor of safety. It was suggested that the construction of such rules would be more worthy of the professional attainments of English engineers, and would be designed to raise the standard of professional knowledge by avoiding the use of fixed coefficients of which the origin and scope were not known to the user, and to encourage good workmanship and the use of materials of a high class by varying the working stress according to the quality of the materials employed. The revival of the Royal Commission of 1847, to effect for wrought iron and steel what was then done for cast iron, was indicated as the best means of obtaining the necessary data for the construction of rules with these objects.

A paper, written by Mr. T. C. Clark and Mr. Macdonald, upon "Louisville and New Albany Bridge," was next read. The paper dealt mainly with the novel features in the superstructure of this cantilever bridge, recently built over the Ohio River.

Mr. W. Anderson opened the discussion by remarking that, in his opinion, English bridge-builders were handicapped by not having any standard form to work to, and he suggested that something of the kind should be provided. It was also important that her Majesty's inspectors should fix a low limit of stress for girders made of steel.

Professor R. H. Smyth (Professor of Engineering at Mason's College) spoke of the difference between pin-joint and riveted-joint structures. Every one, he said, must at once concede greater facility for construction for pin-joints. If a bridge had to be erected in Germany, France, or England, facility of construction was not of such great importance as when it was to be erected in more out-of-the-way parts of the world, and this must be taken into account in any comparison between the two systems.

Mr. Jeremiah Head said he thought the papers were of a useful character. In times like the present, when they were suffering from the badness of the times, there was matter for serious reflection. He had often thought that a great deal more might be done by engineers in availing themselves of the experience which was to be got from contractors in their own workshops. Their greatest constructive experience and mechanical inventions had to a large extent grown up in the workshops throughout the country far more than in Great George-street or any other street in London. This ought to be recognised, and more ought to be done to encourage contractors and manufacturers and others to give engineers the full benefit of their experience and knowledge. The plan of asking contractors to give designs as well as tenders might be carried to the materials of which the things required were made. He did not see why the makers of materials should not be asked to state what tests they would guarantee.

Sir Fredk. Bramwell did not agree with the last speaker that manufacturers should be asked to state what they would supply rather than be asked to conform to specification. The requirements of the engineer being somewhat in excess of the easy production of the manufacturer was one of the best means of ensuring improvements in manufactures. He knew what the tests for steel for guns were at the outset, and he knew how they had been greatly varied. The variations had been largely due to certain conditions which the manufacturers had had forced upon them. The French were able to make a steel projectile which had accomplished in England that which no English projectile had accomplished. He could not help thinking that Mr. Head's suggestion, if carried out, would have the result of leaving them very much in a state of stagnation instead of in a state of progress.

Mr. Bayley Marshall suggested that, instead of placing the factor of safety on the limit stress of any material, they should have a factor of safety which depended on the elastic limit of the material. The means of estimating the elastic limit were now much easier than formerly. It would also be well for engineers to consider the question of the reduction of area at the point of fracture, which was still a vexed question with many manufacturers.

Mr. O. Reichenbach followed with a paper on "Freezing as an Aid to the Sinking of Foundations." The method of freezing the ground in sinking foundations was, he said, patented some years ago by Mr. F. Poetsch, a well having been sunk in this manner as early as 1862. It consisted in freezing the water

contained in the ground, and thus providing a water-tight lining, which enabled the necessary excavations to be carried out without difficulty. The paper gave an account of the manner in which the process was carried out, by passing a freezing liquid down numerous boreholes surrounding the ground to be excavated. After the freezing had been effected, the excavations were commenced, and secured in the ordinary manner, the space between the lining and the excavation being filled with charcoal, &c., to prevent setting fast by freezing. The system was readily applicable in bridge construction, and would at times obviate the necessity of using very large spans. Calculation showed that, to take an imaginary case, the freezing of the ground to sink a pier 60 mètres below water level, and 40 mètres below the river bed, and having a base 18 mètres by 8 mètres, would occupy 2,250 hours, and require a cooling effect equivalent to 2,230 cubic mètres (or tons approximately) of ice. About 2,900 cubic mètres of ground would be frozen in the operation.

"The Lafitte Process of Welding Metals" was dealt with in a paper by Mr. W. Anderson, C.E.

Professor Benton read a paper (before the Geological Section) on "The Surface Subsidences caused by Coal-mining." He pointed out that it is obviously impossible, with the annual output in Great Britain of about 160,000,000 tons of coal, to avoid surface subsidence. This subsidence might be permanently injurious to the agriculturist by destroying the drainage of his land, or even submerging it for a great part of the year under the overflow of the neighbouring streams or rivers. Again, the subsidence might cause permanent injury to buildings by destroying their verticality. These damages might result not only from the removal of the subjacent mineral, but also from the removal of the adjacent mineral. The common law of the country provided that if the coal-owner should so use his property as to damage his neighbour's surface property he should fully compensate that damage; and it generally happened that the real damage was quadrupled in the compensation. In order to avoid such damage, direct and lateral support was given to the surface by leaving considerable areas of coal unwrought. A small building, standing on an area of twenty yards, might require for its support a pillar of coal of 300 yards square, and 6 ft. thick, weighing about 180,000 tons. This weight of coal would provide lateral support from one seam only. In working four other seams of similar depth and thickness near the same building a total weight of more than 720,000 tons of coal might be left unwrought. If it were borne in mind that there were between 2,000 and 3,000 distinct colliery enterprises in this country, it might be safely inferred that much coal was annually left unwrought for the lateral support of the surface. This coal was sacrificed for ever, and was a loss to the owner and lessee of the colliery, and also to the nation. Having pointed out the arithmetical principles upon which an economic support might be given to an undermined surface, Professor Benton suggested that some alteration was needed in the common law with regard to the matter, for the sake alike of equity and of economy,—equity because both mineral and building property should have equal protection, whereas at present the mineral interests were sacrificed for the protection of building interests. This preferential protection was, moreover, abused in a variety of ways. For instance, all fractures of buildings due to defects in foundation and construction were attributed to mining operations in the locality. No compensation was allowed to the mineowner for mineral left for lateral support. A better plan would be that the mineowner should give notice to the owner of the building that the latter should put iron bands round the structure during the subsidence, and that the actual damage should afterwards be assessed by the Crown. Thus buildings would be saved, their owners compensated, and the nation enriched to the extent of the mineral rescued.

Professor Hull said that any proposal which tended to economise coal at this day should receive the most careful consideration. Our coalfields were being very rapidly exhausted. Mining enterprise was being accompanied with continually increasing expense, and in the Midland Counties very large quantities of coal were destroyed by being reserved for such purposes as Professor Benton had referred to. Therefore he thought that the public, as well as the mining interest, should welcome any proposal which tended to lessen the amount of coal that was absolutely left in the mine, and which could not afterwards be recovered, or, if it was recovered, which could only be got in a very damaged condition, and with increased cost.

A paper on "The Manufacture of Metal Tubes," by Mr. J. Robertson, of Glasgow, was read (in the Mechanical Science Section) by Mr. Ralph Heaton. The paper described a process for making metal tubes in which a principle of the law relating to the frictional surface-contact of solid bodies being moved over each other is employed, not generally known as a mechanical means of doing work. The process has been in use for about six years in several of the larger tube manufactories in this country, for making iron and steel welded tubes, and, as the author claimed, has had considerable advantages over processes for the same purpose previously in use. Recently it was introduced in the works of Messrs. Ralph Heaton & Sons, of Birmingham, and adapted to the manufacture of seamless copper tubes. The principle employed is one by which the friction of bodies in contact, which are being moved over each other in one direction, can be greatly reduced. As it is applied to tube mandrels the resistance to a bulb mandrel being passed straightforward through a tube can be reduced to about one-sixtieth by revolving it. Most saving in power seems to be effected when the cross motion is about equal to the longitudinal traverse. The result of the application of this principle to the making of cold-drawn tubes is that they can be made at less cost than by any mode of casting them. The paper went on to describe in detail the process of making the tubes in accordance with the principle referred to. A number of tubes in various stages of manufacture were exhibited to the audience. Described briefly, the process is as follows:—Round bars or "billets" of metal are fixed firmly in a matrix. The "billet" is then pierced to the required diameter by the mandrel which revolves, and is pressed forward with great force. This is accomplished without taking any metal out of the "billet," the metal being laved or spun aside by the mandrel as it forces its way through. This necessarily elongates the metal, and at one thrust a "billet," 2 ft. 3 in. long, is transformed into a "shell tube" 4 ft. long. In this state the shell may be taken to the ordinary draw-benches, and finished into tubes of required diameter.

The President of the Section (Sir James N. Douglass) spoke very highly of the paper, and described the invention as of great value, both from an economical and mechanical point of view.

Several practical mechanicians also spoke highly of the invention.

Dr. R. H. Mill read, in the Geographical Section, a paper on "River Entrances." He said that the want of a proper geographical definition of a river led to considerable difficulty in some cases, when it was of importance to know exactly where the river ended and the sea began. That definition might be supplied by considering the physical conditions of the water. A preliminary classification of river entrances divided them into those connected with inland seas, *e.g.*, the Caspian; those connected with tideless enclosed seas, *e.g.*, the Mediterranean; those connected with tidal seas. River entrances of the third kind were of most interest in this country. A typical river system of the third class comprised a river gradually widening and deepening as it merged into a funnel-shaped sea inlet. Some rivers had no firth, others had neither firth nor estuary; the size, position, and character of each region depending on the ratio between the volume and velocity of fresh water in the river to the size and configuration of the sea-inlet into which it fell, and also to some extent on the weather and on tides. The only British river-system which had been pretty fully investigated physically was that of the Forth. The Clyde, Tay, and Spey had been examined in a preliminary manner; and the Thames, the Bristol Channel, the Wash, and the mouths of the Mersey, Ribble, Humber, and Shannon were worthy of special study. The observations required in such researches as carried on by the Scottish Marine Survey were temperature at surface, bottom, and intermediate depths; density of the water as a measure of salinity at the same places; amount of suspended matter and transparency; and alkalinity as a measure of dissolved calcium carbonate.

Dr. Mill also read a short paper on "Configuration of the Clyde Water System," in which he gave a topographical description of the natural divisions of the district, and of the true relations in it of land and water.

General F. H. Rundall, C.S.I., R.E., read a paper (in the same section) on "The River Systems of South India." He gave an account of the physical features of the peninsula, describing its several mountain ranges and plateaux, its general meteorological phenomena, and the effect which its peculiar configuration had on the quantity of rainfall and its distribution, and then enumerated the principal river basins which served to carry off the rainfall, distinguishing them in their respective types, indicating their relative positions, specifying their respective tributaries, and detailing particulars as to their areas, length of course, prevailing geological formation, and special characteristics. After explaining that the four great delta river systems occupied about five-sixths of the eastern drainage area, General Rundall entered on a detailed description of those rivers throughout their respective courses, the phenomena attending their floods, the measures adopted for keeping them under control in the lower or deltaic portions, the character of the estuaries, the formation of the delta, and the great systems of irrigation and navigation which had been constructed therein. In conclusion, he noticed the value of water in India generally, and in South India particularly, both for irrigation and navigation purposes, and enumerated the measures which had been adopted by the Indian Government for the promotion of such works, giving an outline of what had already been accomplished, and of what still remained to be done.

General Sir Henry Thuillier commended the paper of General Rundall to all interested in the geography of India, and it was unanimously decided by the Section that the Royal Geographical Society should be asked to publish the paper in their Proceedings.

A paper by Mr. F. de Lesseps, on "The Panama Canal," was read in the Geographical Section by Mr. A. S. White. The author glanced briefly at the geographical features of the Isthmus of Panama, and then referred to the apparent necessity of a means of communication between the Atlantic and the Pacific. He mentioned some of the projects which were entertained from the early part of the sixteenth century, when the geography of the isthmus was only imperfectly known, to the year 1875, when, at the Geographical Congress in Paris, it was decided to begin entirely anew a study of the isthmus, and of the various plans for creating a way of communication from ocean to ocean. As a result of that Conference two naval officers, MM. Reclus and Wyse, were despatched to make a survey and draw up a report. After three years' incessant labour they returned to Paris. A new Congress met in 1879, and decided by a majority of seventy-eight that the canal should be constructed between Aspinwall and Panama, without tunnels or locks, from ocean to ocean. The route of the new waterway would be from the east side of Limon Bay, on the Atlantic side, then by the valley of the Chargres and Rio Grande, towards the Bay of Panama, joining the Pacific near the islands Naos and Glamenca. Its entire length would be seventy-three kilomètres, or forty-five miles, and it would be constructed like the Suez Canal, without any obstructions. On the Pacific coast, however, a tidal lock would be built, so as to be independent of the tides. The average depth of the canal would be nine mètres below the main level of the ocean. A dam would be constructed at Gambor to regulate the waters of the Chargres. M. de Lesseps anticipated no difficulties in cutting the canal. Two ports would be created, one at Aspinwall or Colon, and the other at Panama. The former was nearly completed, and the latter presented no difficulties. In the work of the canal from 15,000 to 20,000 workmen were engaged, and M. de Lesseps believed that it would be finished by the end of 1889. He then entered into the consideration of the importance of the canal for the commerce of the world in general, and expressed an opinion that vessels aggregating ten millions of tonnage would pass through the canal, paying dues at the rate of 15 francs per ton.

TECHNICAL EDUCATION AND THE BRITISH ASSOCIATION.

IN the Section of Economic Science and Statistics, at the British Association meeting, Birmingham, Sir Philip Magnus read a paper on "Manual Training," a subject which, he said, had been carefully considered by a committee appointed to continue inquiries relating to the teaching of science in elementary schools. They had reported to the Council of the Association that it was desirable to make representations to the Education Department, and suggested that the encouragement for the teaching of handicraft work might take the form recommended by the Commission on Technical Instruction, so that the use of tools in boys' schools might be placed in the same position as practical cookery in girls' schools. It could not be too often repeated that the object of workshop practice, as a part of general education, was not to teach a boy a trade, but to develop his faculties, and give him manual skill, and to familiarise the pupil with the properties of such common substances as wood and iron, to teach the hand and eye to work in unison, to accustom the pupil to exact measurement, and to enable him, by the use of tools, to produce actual things from drawings that represented them. Sir Philip pointed out the collateral instruction that could be given in connexion with the teaching of handicrafts, and showed that while the faculties of the children were being usefully exercised, and the area of their knowledge was being extended, they were at the same time acquiring manual skill which could not fail to be useful to them in every trade. Experiments of introducing workshops in elementary schools had been tried in this country, with results sufficiently encouraging to justify the extension of the system; and on the Continent and in the United States much was done in technical teaching. An enthusiasm was spreading among Americans in favour of workshop instructiou, which was likely to have an important influence on the industrial progress of that eminently practical and inventive people. As a general rule, Sir Philip Magnus suggested that children should be required to have passed the fifth standard before being admitted into the workshop. He estimated that not more than 30,000 boys would be ready to receive workshop instruction in this country, and the additional Government grants might be 5,000*l*. For this comparatively small expenditure about 30,000 boys might be annually sent out into the world from elementary schools with practical skill at their finger ends, and imbued with an aptitude and taste for the real work of their life. The importance of practical teaching, of studying things before words, had been many times urged, but as yet, such had been the inertia of school authorities and teachers, and such the force of tradition, that we were only now beginning to employ the methods of instruction that had been reached for years by the most eminent educational reformers. It was hoped that the committee of the Association would persevere in the representations it had already made on this important subject, and that the labours of the Royal Commission might result in making our elementary school teaching more practical, less verbal, and less mechanical. They asked that in the new Code it might be provided—(1) that the subject be duly recognised, so that no part of the attendance grant be lost in consequence of the time devoted to it; (2) that School Boards be empowered to erect and equip workshops in or near elementary schools for the instruction of children who had passed the fifth or qualifying standard; (3) that grants be paid by the Government on the number of children receiving instruction and making the required number of attendances.

Mr. W. Ripper read a paper on "Technical Instruction in Elementary Schools." Experimental science was almost unknown in our schools, and, as a consequence, the children went out into the workshops and factories crammed with information about moods and tenses, but absolutely ignorant of the elementary principles which would enable them to reason intelligently upon the physical facts and phenomena by which they would be continually surrounded. Systematic science instruction was being given in the Board schools of Birmingham and Liverpool, and with excellent results. The children were interested in their school work; they acquired information which no amount of mere book-reading would give them; and the advantage of such instruction would be reaped, not by the children alone, but by the whole community. The idea in the minds of many people had been that education was going to save their children from hard work, and the present system of instruction was still in danger of encouraging this notion, and of creating habits and tastes which may unfit the mind for the work before it, instead of fitting and aiding it. There could be no greater fallacy than to imagine that any boy was too good for the workshop. The workshop urgently needed these very boys, and if the public elementary school was not helping to enlist its best talent on the side of skilled labour, we were not on the right course. A more practical system of instruction was destined to grow and to occupy an important place in our educational methods of the future, the aim of which would be, while sacrificing none of the present advantages, to enable the schools to render more efficient help than in the past, to the nation's industrial progress.

The Rev. H. Solly read a paper on "Technical Education," in which he urged that the apprenticeship system having for the most part broken down, the practical training of the workshop must be supplemented by the combined practical and scientific teaching which can be given only in the class-room. Systematic and scientific instruction in the principles which underlie all manual industries, and the application of those principles to the material of each handicraft, is essential for thorough technical training, and can be given only by class teaching, not in the workshop. At present it is apparently no one's interest, nor legally any one's duty, and certainly no one is in general qualified to give this instruction to apprentices or youths; while it too often appears to be the employer's interest to keep the lads in particular grooves of work, from which they learn nothing but very limited routine dexterity. Other nations have long since acted on a wiser system, and we are feeling the consequences. The remedy is to secure systematic and thorough technical training for the rising generation of artificers, by returning to a regular system of "indentured apprenticeships," whereby the employers, if they take lads at all into their workshops, shall be bound to see that they attend technical training classes for a certain number of hours in the week during the first three years of their apprenticeship. The increased value of the services of the apprentice during the remainder of his term, and in some cases money premiums, should recoup the employer.

A paper on the "Economic Value of Art in Manufacture," by Mr. Edward R. Taylor, was read for him in his absence. The lack of beauty in many English manufactures arose not so much from bad taste on the part of the purchaser as from the producer's want of artistic culture. In that case supply must precede demand. Manufacturers too often ignorantly regarded art as an adjunct, instead of an essential, to their wares. Art, on the contrary, should be studied with as much daily care as the other branches of the manufactory. Facts were adduced to show that it is only when such care had been devoted that the work would live and be most pecuniarily profitable; and the attention which on former times was given in this direction was contrasted with the comparatively small amount of thought now, in several instances, devoted thereto. Artistic manufactures might be advanced: (1) By the encouragement of all hand manufactures and decoration; (2) by counteracting the apparently natural tendency of machinery and other inventions to vulgarise art by the inordinate use of ornament of a poor character; and (3) by making the training of the eye and (by the use of tools) of the hand an essential part of education from the beginning of school life.

A discussion followed, in which Mr. Fellows, Mr. G. Hurst, Mr. W. Botley, Mr. Spratling, and Dr. Gladstone took part, and objection was expressed by some speakers to any increased grant for purposes of technical education.

Sir P. Magnus, in replying, said having regard to the system of elementary education they had adopted, unless the Government took up the subject of manual training it was not likely to be dealt with. He had desired to point out in his paper at how small a cost this could be done.

THE COLOURS OF METALS AND ALLOYS.

IN connexion with the Birmingham meeting of the British Association, on Saturday evening last Professor W. C. Roberts-Austen, of the Royal Mint, delivered, in the Town-hall, to a very large audience of working people, a lecture on the "Colours of Metals and Alloys." Sir W. Dawson, C.M.G., President of the British Association, occupied the chair.

Professor Roberts-Austen stated that under the title of the lecture he intended to include the consideration of the principal facts connected with the colours of metals and alloys, whether natural to them or produced by metallurgical art, as well as a brief examination of the kind of influence which the colours of metals appear to have exerted on the history of chemical science. With reference to the recognition of colours of metals by the ancients, he referred to the view expressed some years ago by Mr. Gladstone, "that the starting point is absolute blindness to colour in the primitive man," and he urged that, if this be true, it is strange that in the metal-work or fabrics of savage nations, the arrangement of such colours as they can obtain should be so thoroughly "understood," and the colours themselves so discriminately employed. Allusion was then made to the ancient belief that the seven metals known to the early chemists were specially connected, as regards colour, with the seven principal planets; to the persistence with which this belief survived, and to the fact that Sir Isaac Newton did not escape the charge of leaning towards mysticism when he stated that seven colours resulted from the decomposition of light by the prism. In relation to the influence of the colour of metals on the history of science, it was pointed out that from the third to the seventeenth century the colour of gold appeared to haunt men, and induced the alchemists to make the strangest sacrifices, even of life itself, in the attempt to produce it. The alchemists were sustained by the knowledge that the colour of metals could be destroyed by small traces of impurity, and an appeal was made to the argument of even the "sceptical chemist," Robert Boyle, in the seventeenth century, that transmutation of base to precious metals is possible, because he destroyed the colour of gold, and believed that he had degraded gold to a base metal by the addition of a small quantity of a substance "given him by a stranger"; "it being," as Boyle said, "no small thing to have removed the bounds which nature has industriously set to the alteration of things." In illustration of the apparent degradation of gold by the presence of a small quantity of certain other metals, Professor Roberts-Austen melted 200*l*. of sovereigns, added a tiny shot of lead, and proved that the bar into which the metal was cast was very brittle, and entirely different in colour from the original gold. The dependence of the colours of metals on their physical state of aggregation was then illustrated by some beautiful experiments with leaf-gold and with Faraday's finely-divided gold of bright ruby colour. The lecturer then passed to the effect of colour produced by alloying metals by melting them together. He incidentally said that he had many inducements to speak about brass, in particular he would have liked to dwell upon the beauty of such work as that of the great craftsman (William Austen) who, in 1460, made the magnificent monument in brass to Richard Beauchamp, Earl of Warwick, and he was glad to remember that the first patent for the manufacture of brass in England had been granted to W. Humphrie, an assay-master of the Mint, and a predecessor in the office he (Professor Roberts-Austen) was privileged to hold, but he did not, he said, intend to say much in Birmingham of the coloured alloy of zinc and copper which was its staple industry. His object was to claim the attention of the metal-workers of Birmingham to the coloured alloys of copper with which they were less familiar, and he referred at length to the alloys which had been used for centuries by Japanese art metal-workers, the images of typical specimens of whose handicraft were projected on a screen. Special reference was made to a large plaque of copper inlaid with foliage, which in colour suggested the glories of a Canadian autumn, and it was stated that the addition of small quantities of gold, antimony, and cobalt to metallic copper enabled the Japanese to

secure each beautiful shade of colour of purple, golden browns, and reds, for which their art metal-work is so remarkable. In illustration of the effect of various "pickling" solutions on copper, Professor Austen had himself prepared a trophy, 7 ft. high, of richly-coloured leaves. Attention was then directed to the singular banded alloy known as moku-me, the manufacture of which, now almost abandoned by the Japanese, Professor Austen is anxious to see introduced into this country, and he projected on the screen the image of a dagger-hilt of old Japanese native workmanship, in which, as a *tour de force*, the artist has reproduced the purple and brown markings of a "scarlet runner" bean. A brief reference was made to the fact that the electro-metallurgist has at command, in the power of being able to deposit coloured alloys, an equivalent of the varied palette of the decorator, and admirable specimens of coloured alloys, deposited by Messrs. Elkington's well-known firm, were exhibited. It was incidentally stated that one firm deposited annually six tons of silver in thin films which, if continuous, would, it had been calculated, cover an area of 140 acres. Professor Roberts-Austen then showed experimentally, by projection on the screen, the formation of coloured films by heating lead in air, and he claimed that the formation of a coloured calx of lead by heating the metal in air had been more frequently appealed to in support of various sets of views than any other fact in the history of science, from the time of Geber in the eighth century to that of Priestley in the eighteenth. This experiment was of special interest to Birmingham, because, performed in a rougher way, it had directly led Priestley to the discovery of oxygen, and had removed his doubts as to the aërial source of the oxygen he obtained from other substances. Professor Roberts-Austen concluded with a sentence from Mr. Ruskin's "Modern Painters" as to the right enjoyment of colour, and with a plea for the more careful study and extended adoption of coloured metals and alloys in objects intended for daily use, and for the restricted employment of gold and silver to their legitimate purpose of enriching metallic ornament.

THE TRADES' UNION CONGRESS.

THE nineteenth annual Trades' Union Congress was commenced on Monday last at Hull. The retiring President (Mr. Maudsley) received the delegates, who were also formally welcomed to the town by Mr. H. H. Biggs, the Sheriff of Hull (acting for the Mayor, who was absent through indisposition.

Mr. Maudsley, in addressing the Congress, said, with regard to the condition of the labour market, that affairs were about in the same state as at the close of the last Congress held at Southport. Seeing that the wealth of the world, absolutely and relatively to the population, was as great as ever, they ought to address themselves to the consideration of some remedy for the great lack of employment now existing. In his opinion, working men were at the present time working too many hours,—not that they were producing too much, but that the production was by the hands of too few people. They could not have too much production, but the result of the present system was that many men, being excluded from a share of the labour in the market, were unable to purchase their share in the produce of the world. Too few people were in the position of producers. If the many people could not purchase the products of those at work, they became a double drag upon the employed, as well as unable to secure that self-respect due to British workmen. Having stated that the Congress was willing to assist struggling trade unions, and to help respectable workpeople to form labour unions, he said that, in view of the condition of the labour market, the present Congress was the most important held since the first held in 1868. He had the honour of being present at the recent International Trade Congress in Paris, and was glad to find that the revolutionary ideas formerly somewhat prevalent were giving place to trades-unionist ideas. The younger class of French artisans were forming organisations on the British system, and it seemed to him that united action on the part of European workmen was now nearer at hand than before.

The following officers were elected:—President, Mr. F. Maddison, Hull; vice president, Mr. J. Judge, Leeds; secretary of Congress, Mr. K. G. Wilkinson, Hull; auditors, Mr. Elvidge, Hull, and Mr. Pickard, M.P., Barnsley. Standing Orders Committee: Messrs. J. Wilson, Durham; J. Battersby, Glasgow; J. Swift, T. R. Threlfall, Southport; and C. J. Drummond, London.

Mr. George Shipton, secretary *pro. tem.* of the Parliamentary Committee, presented its annual report. In this the committee regretted that, owing to the unprecedented political vicissitudes of the past year, they were unable to place before the Congress that record of Parliamentary successes which, under more placid conditions, might have been possible. Workpeople had been pressed by difficulties on all sides. The continued depression in almost every industry had had its serious effect in reducing their funds, testing seriously the allegiance of members, as well as the solidity of their organisations. It might, however, be truly said that in proportion to the severity of the trial had the self-reliance and value of the institutions been demonstrated. The committee proceeded to state what had been done in relation to the resolutions passed at the last Congress. First, with respect to the Employers' Liability Act, which would lapse in 1887, the Select Committee appointed by the House of Commons had presented a report which contained very valuable, although probably inadequate, recommendations as to what the future Employers' Liability Act should be. It was satisfactory to note their resolution that the Act should, with its amendments, be permanent. The committee urged the expediency of reintroducing Mr. Burt's Bill to prevent workmen contracting out of the Act. They regarded it as an imperative duty to call, through the Congress, the attention of the industrial population of the country to the great benefits they had in so many cases derived from this one measure. In the first instance there had been great caution exercised by employers in consequence of responsibility, and this had resulted in greater protection to the lives and limbs of those they employed. The number of cases tried in County Courts during the five years 1881-5 had been 882, and the amount awarded 34,362*l*. The number of cases removed to higher courts was twenty-one, and the number of cases settled out of court 249. In regard to factory and workshops inspectors, it was remarked that, should the expediency of workingmen appointments not receive due attention, it would be necessary to continue the strongest pressure in the right quarter in order that the law might be made a living reality, and not a dead enactment. The resolution requesting the committee to induce the Government to make eight hours the maximum working day in all their departments and workshops had received the best attention of the committee. The immediate realisation of this request, however, they found would be hopeless. The whole question was involved in complications. There was no doubt, however, that under the present system a pernicious process of systematic overtime was frequently brought into operation in the dockyards and arsenals, and that about every four men employed shut out by working overtime a fifth, who was thus denied the opportunity to live by his industry. After expressing satisfaction at the recent appointment of workmen to the magisterial bench, the committee referred to the newly-established Bureau of Labour Statistics, and congratulated the Congress on the choice of Mr. John Burnett as official correspondent. A number of other subjects were referred to as having occupied the attention of the committee, though no progress was chronicled during the past year. They closed by an expression of alarm that, owing to unlimited competition, nationally as well as internationally, intensified power of production, and a rapidly-increasing population, the power to live by labour was becoming, under existing conditions, more difficult year by year. Trades' unions had only begun their work. They must in future endeavour to be equal to the several necessities and aspirations of the workers, or they would not be exempt from the law of supercession and decay which attended even empires when their industrial populations were allowed to fall into want and misery.

The reading of this report having been concluded, the Congress adjourned.

On Tuesday morning there was a full attendance of delegates, who, it was reported, numbered 143, representing trade unions with an aggregate membership of 643,000. Amongst them were several female delegates.

The President (Mr. F. Maddison), in his address, said they were met at a time when thinking men of all classes were looking into the questions which affected the well-being of the people. Amidst this activity it was essential that the working classes of this country should have leaders able to guide them into the paths of safety and prosperity, and secure for them those rights which had too long been withheld. In his opinion, nobody had such a claim to be the leaders of the workers of this country as the Trades' Union Congress. It stood as the only representative of British Trades Unions in the aggregate. To perfect its mode of operation, and make it still more effective for the good of the toilers, were objects worthy of their best energies. He trusted that in the future the trades of the kingdom might even to a greater extent unite with the Congress. Splendid as had been the records of Unionism in the past, and in spite of the benefits conferred by its influence on the skilled workers of the country during the last twenty or thirty years, they must, nevertheless, as candid men, admit that the condition of the workers generally was far from satisfactory. Discontent was general. Political economists might say what they liked, but it could not be the will of Providence that the labourer should be doomed to toil that others might enjoy the products of his industry. He thought that one of the first steps taken by the Congress should be in the direction of the eight-hours movement. While there were large numbers of their fellow-workmen unable to find employment, it became them to see whether the number of hours worked could not be so shortened as to secure them work. The adoption of the eight-hours system would lead to the employment of probably half a million more people. Additional employment would also be available if a stop were put to systematic overtime. As for foreign competition, that must be prevented by more missionary work on the Continent on the part of English trades unions, and by increased means of technical education here. Much of the existing congestion in the labour market he traced to the tendency, so marked of late years, of our agricultural population to crowd into the large centres of industry, because they could not live in the country. To remedy this, the land laws should be amended, if not entirely remodelled, in the direction of land nationalisation. As for emigration, that ought only to be promoted if there was a reasonable prospect of the emigrants benefiting themselves, and not congesting the labour markets of the colonies. He regarded co-operation as a legitimate development of trade unionism, and urged that everything possible should be done to encourage and establish the system. He desired also to see the federation of trades carried further, and labour more directly represented in Parliament.

The Employers' Liability Act.

Mr. J. S. Murchie (Manchester) moved: "That this Congress hails with satisfaction the prospect of the Employers' Liability Act receiving the attention of Parliament at an early date. It nevertheless urges the Parliamentary Committee to persevere with the matter until a perfectly satisfactory measure is secured, which must contain the principle of Mr. Burt's Bill, rendering any contract out of the Act no bar to action for recovery of compensation for injury."

Mr. W. Hey (London Ironfounders), who seconded the resolution, complained that employers, by insuring themselves against claims made under the Act, lessened the motives for carefulness, and avoided the law costs which the workmen had to face in these cases.

Mr. Holmes (Leicester) adduced reasons why the Act should be made obligatory.

Mr. C. Bloor (Burslem) represented that insurance against the liabilities of the Act was unavoidable in the cases of small employers.

Mr. Drummond thought the Parliamentary Committee of the Congress might be empowered to afford workmen legal assistance in claims under the Act.

Mr. Mosses (Glasgow) was opposed to the Act being made compulsory. The number of men who had obtained compensation under it was small compared with the number who had sued their employers, and the comparatively few who had actually obtained compensation were

little to be envied, after the costs, delays, and uncertainties of the law. A well-considered scheme of insurance, contributed to by both workmen and employers, would be much preferable. He believed that 90 per cent. of the accidents were attributable to the negligence of the workmen themselves.

Mr. Benjamin Pickard, M.P. (Barnsley), protested against this last allegation. While he had no objection to insurance schemes against accidents, he held that the Employers' Liability Act should be made compulsory. If the Act was necessary at all, everybody should get the benefit of it. It was mainly valuable in its tendency to prevent accidents, and not for the money compensation it provided for the sufferers.

The resolution was carried unanimously.

We may have more to note about the proceedings of the Congress in our next.

ARCHITECTURAL ASSOCIATION SATURDAY VISITS.

THE Architectural Association on Saturday, the 3rd inst., made an afternoon visit to Kent Hatch, Westerham. This house was built three years ago from the designs of Mr. M. Macartney, who met the members, and conducted them over the house.

The general arrangement consists of a long corridor or gallery, out of which lead the drawing and dining rooms, the staircase being at the opposite end to the drawing-room, and the entrance-hall in front of the staircase. The dining-room is a very picturesque room, with plain oak ceiling, and tapestry-covered walls, the fireplace being arranged in an ingle nook, and one end of the room having a raised floor, with an oak arcade and balustrade. From this raised platform, a door leads to the wine-cellar staircase and small room at the back of the fireplace. The drawing-room has a magnificent view across the Weald of Kent. The staircase, which is of oak, is separated from the gallery by an oak arcade. On the half-span is the billiard-room, with separate staircase to the entrance-hall; and on the first floor are a studio and bedrooms. The general treatment of the elevation, with half-timber work,—the timbers being of oak, and some of the walls weather-tiled,—is a very clever rendering of the type of Kentish homestead.

After leaving Kent Hatch the church at Westerham was visited. The whole of the work of the church is Late Perpendicular, with very poor detail. The nave arcades have very wide arches at the east end, and they, springing from a lower level than the western arches, have pushed the columns out of the perpendicular, and have a very awkward effect. There are a few interesting monuments in the church, one to General Wolfe, who was born in Quebec House. This house, which is close to the church, and which can be best seen from the churchyard, is a picturesque mass of gables. The interior was not visited.

CASE UNDER THE METROPOLITAN BUILDING ACT.

AT the Hammersmith Police-court, a summons was heard before Mr. Paget, on the 3rd inst., taken by Mr. T. E. Knightley, District Surveyor for Hammersmith, against Mr. H. McCowan, of West Hampstead, for having resumed and carried on works to four blocks of artisans' dwellings in the parish of Hammersmith, which had been abandoned by a builder named Scott, without giving notice as directed by sec. 38 of the Act.

Mr. Knightley stated that he had twice asked for the notice, but without effect. The buildings were carcasses at the time they were resumed by defendant; the doors and window-frames remained to be fixed, hearths to be laid, and brickwork to be built to coppers and sleeper walls. There were errors in the work, and he could not proceed for amendment until notice had been given by defendant.

A Barrister appeared for the defence, and alleged that the work above referred to was "internal decorations," and called witnesses to show that no structural work remained to be done by Mr. McCowan, who had done nothing which brought him within the Act; but Mr. Paget, after a long hearing, said that the works named by Mr. Knightley were clearly such as required notice. It was an obstinate and determined attempt not to obey the law. He fined the defendant 10*l.* penalty and 20*s.* costs.

THE ROYAL ACADEMY.

SIR,—Mr. W. H. White's letter in the *Times* of the 30th ult. expressed his personal views only, and was written without the authority or knowledge of the Royal Institute of British Architects. G. AITCHISON.

GATES AND TRICYCLES.

SIR,—I beg to make a suggestion as to gates, the following out of which would often enable an owner of house property to let his house in preference to others in the neighbourhood, with equal advantages in other respects.

So many householders own tricycles now that a *wide* gate has become almost a necessity, say, not less than 45 in. Room should also be given in the same manner at the side of the house, in order to allow the tricycle to be taken into the back premises. THE ANGLO-DUTCHMAN.

The Student's Column.

STONE QUARRIES.—XI.

THE CHANNEL ISLANDS (CONTINUED).

Guernsey.

THE quarries here were first extensively worked about fifty years ago. Nearly all of them are situated in the northern half of the island. The stone obtained is described by some as being all granite, and by others as all syenite. As a matter of fact, although syenite is quarried, yet by far the greater quantity of stone raised is hornblendic granite. It is, however, of quite different appearance from the hornblendic granites of Jersey or Leicestershire, being either a dark green or grey colour.

In examining a large collection of Guernsey stones, one is often met with the difficulty of discriminating the difference between the syenites and the hornblendic granites, owing to the variable occurrence of the mica. Sometimes it is a very distinctive feature in the rocks, and at others, is so rare as to rank only as an accessory mineral. From this it will be seen that the quality of the stone is also variable, a fact that should be borne in mind by those who habitually regard Guernsey "granite" as of one quality only. There can be no doubt that the road-metal and kerbstones obtained from this island are, generally speaking, first-rate; but uniform quality must not be expected, even from such a limited area as that now under consideration.

Then, again, the grain of the rock differs considerably in some cases, even in that obtained from the same quarry. The hornblende ranges in size from mere microscopic specks up to crystals half an inch or more in length, and often so predominates as to cause the stone to be made almost wholly of that mineral, which has a high specific gravity. We notice that several veins of hornblendic rock occur in the island, and in one large quarry crystals of hornblende and schorl were distributed in the ground mass, in a very conspicuous manner. Quartz never occurs here in large crystals, and the mica is generally represented by very little flakes. The felspar appears to be mostly triclinic, of white or light green, and exceedingly minute; orthoclase is found in the rocks from the western side of the island. Iron pyrites is often seen in the coarser varieties, and in the schorlaceous veins just alluded to, it occurs in lumps an inch or two in diameter.

The finer-grained rocks all agree in being very tough and compact, especially when mica is rare or absent, and this is why they are so eminently suitable for road-metal. The "crushing weight" of Guernsey granite is occasionally quoted on this side of the water as though all the stone were obtained from one quarry, of uniform structure, and capable of bearing exactly the same stress, neither more nor less. As the student will see, this is a great mistake, and the sooner it is acknowledged the better. The resistance to crushing in rocks of such variable structure must vary considerably, and many more experiments will have to be made before anything like satisfactory conclusions can be drawn in regard to their strength. Until that time arrives, those engineers and surveyors who have not made up their minds that the number of recorded experiments is wholly inadequate to express the practical utility of much of the stone, may safely arrive at that determination. Probably, that time will never come, and, as regards the material obtained from quarries exclusively worked for road-metal, we do not think that such experiments are needed (see *ante*, p. 147).

"Granite" is the chief export of the island, and its magnitude and importance may be seen on going to St. Sampson's Harbour, a place about two miles north of St. Peter Port. Here is a magnificent harbour, in which ships are being filled with granite, stupendous stacks of pitching and kerb stones, and huge heaps of broken stuff being in readiness for shipment. We are informed, on good authority, that the total amount of stone annually exported from the island is not less than 220,000 tons. In the year 1885 it was as follows:—

	Tons.
From St. Sampson's Harbour ...	197,000
From St. Peter Port	17,782
	214,782

Of this, Guernsey vessels alone took 120,000 tons. It is sent principally to London and to towns in the south of England and Wales.

In describing granite areas, we have hitherto given the names of the quarries and the particular kinds of stone obtained therefrom, but if this were attempted to be done with Guernsey, we should not only present the student with a long list of French names, which would be decidedly unprofitable, but considerable tautolgy would be inevitable in the description of the rocks. To get an idea of the great number of quarries here, one has only to look round on all sides at the multitude of windmills, so close together. These windmills, as a rule, mark the existence of quarries, for they are used to pump the water up from the bottom of the workings.

Large quarries, such as the Juas and Baubigny, have powerful steam cranes at work, which are used to lift carts from the road at the top of the quarry, to the floor of the workings, where they are filled, and lifted up again to places where horses are in waiting to take them away. This saves a considerable amount of labour. It is a curious sight to see the carts hitched on, swung round, and suspended in mid air over a deep precipice, down which the men at work look like dwarfs. There is an incessant din created by the noise of the hammers, chisels, and crowbars of the workmen, reverberating against the solid walls of the wide gulf.

Both powder and dynamite are used in blasting the stone, but we saw no rock-drills at work, and were informed that they are not used in the island. Surely they might be advantageously employed.

Herm.

The stone obtained from Herm is very similar in appearance to that of Guernsey. It usually contains mica, in addition to the other three minerals, and most of it might be described as hornblendic granite. It is used chiefly for paving.

ABERDEENSHIRE GRANITES.

The granite quarries in this part of Scotland are unquestionably amongst the most important in the United Kingdom, and stone from some of them has been sent into the market for the last century.

Aberdeen granite is known, not only in Great Britain, but in many foreign countries, even as far as the antipodes. The quarries are situated on two distinct masses of granite, which differ from each other in a marked manner. Those on small and isolated patches we shall refer, as usual, to the nearest main mass with which they appear to be related. The two principal masses we shall designate (1) the Aberdeen district, and (2) the Peterhead district. Generally speaking, the Aberdeen granite is of a grey or light blue colour, and the Peterhead pink or red. There are exceptions, however, to these rules.

The rock of the former district in some places shows a rough tendency to foliation, and would, perhaps, more correctly be called granitoid gneiss. It presents the appearance of rock that has undergone extreme metamorphism. It is incorrect to allude to this foliation under the term stratification (as is very often done, even by those in the quarries), with which it does not necessarily bear any relation whatever. Foliation is that structure, generally independent of stratification, in which the rock mass is formed of thin laminæ or folia, each of them consisting of separate mineral layers or crystals, arranged in parallel bands, and with their longer axes placed lengthways, coincident with the laminæ. The cause of

foliation, like cleavage, is apparently connected with pressure.

As we have previously pointed out, true granite is an igneous rock, produced in some cases by excessive metamorphism of both sedimentary and igneous rocks, and in others we have no evidence that it has resulted from the alteration of other rocks, but may, perhaps, originally have been of igneous origin.

We desire to dwell a little on this point, as it affects Aberdeen granites particularly. When, by reason of superincumbent pressure or otherwise, sedimentary and stratified rocks are highly heated, they gradually begin to change their form, being assisted in the process by very hot water, which thus has its power to do chemical work increased. Clay is turned into slate; sand and sandstone into quartzite; and limestone becomes highly crystalline. When these rocks, not being wholly free from foreign matter, are subjected to still greater pressure, all traces of former planes of stratification are lost, according to the degree of alteration induced. Now, if we take the roughly-foliated Aberdeen rock alluded to, it will be seen that pressure has altered this rock still farther even than gneiss; in other words, it is gneiss just on the point of melting, and if it had proceeded a little longer, when consolidation set in, it would have become true granite. As it is, however, it is neither one nor the other. That part of the mass which has undergone such complete metamorphism as to have become true granite, often has small masses of gneissose and schistose rock in it.

Dr. James Geikie, in a paper on the metamorphic origin of granite, states that in the grey granite of the southern uplands of Scotland, he finds "nests" of altered rock, consisting of dark fine-grained or semi-crystalline rock, often showing traces of lamination. Sometimes, there is a sharp line between the granite and the included fragments; at other times, the passage is gradual. They may be remnants of thin bands or beds of shale interleaved in the original strata, from which the granite has been derived by metamorphic action; for, if they were fragments broken off, they should be more abundant near the junction, which they are not. He concludes that these granites have resulted from the alteration *in sitû* of certain bedded deposits.*

There is, no doubt, much truth in this, and the roughly-foliated masses of Aberdeen granite may be looked upon in a great measure as the remains of metamorphic rocks, they having withstood the action which caused other rocks in the vicinity to become true granite.

RECENT PATENTS.

ABSTRACTS OF SPECIFICATIONS.

11,159, Paperhangings. W. Scott.

The paper is prepared with starch or paste; and mica or talc which has been calcined is caused to adhere to it. The paper is also printed with designs in the ordinary way, and is passed through hot calendering rolls, which operation gives it a silky appearance. It is also washable, or at least may be cleaned by simply rubbing with a flannel or cloth.

8,314, Copings and Gutters. S. Watson.

This invention is designed to obviate the dripping of water from the copings as ordinarily made, by making a kind of coping and gutter combined, which is fixed in the usual way to the top of the wall. The central portion of each block is made of such a shape that the rain-water will flow therefrom to the sides of the block, which are made in the form of gutters, the ends of each overlapping, and the water being led away as in a fixed gutter.

7,675 and 7,676, Cements. H. Mathey.

The first of these specifications relates to the manufacture of cements, and claims to effect an improvement by first crushing the natural cement stone to a suitable degree of fineness, then thoroughly mixing crushed clay with the stone, and burning these elements together, and adding, after burning, a pulverised metallic ore roasted separately to form an oxide, and finally pulverising the stone, clay, and oxide together. The second specification refers to a method of colouring cement. A dark-coloured cement is usually preferred, as this indicates an excess of sand. Light-coloured rock cement may be improved and darkened as well by adding oxide of iron before the pulverisation, when it is diffused throughout the cement, which then takes a homogeneous tint.

4,931, Pavements. W. C. and E. F. Murdock, Washington, U.S.A.

Paving blocks or tiles are bevelled outwards from top to bottom on two opposite sides, and in the opposite direction on the other sides. When the blocks or tiles are moulded, wedges or wedge pieces are fitted into grooves in the mould, which allows the block to be taken out. The idea seems to be the dovetailing of one edge of the tile into that of the next in position.

5,122, Domestic Fireplaces. J. Bonny.

The improvement is simply connecting open domestic fireplaces with the chimney by a short pipe, contracted in the centre to produce a quick draught.

4,795, Flushing Drains, &c. S. H. Adams.

The drain is flushed intermittently and automatically by a tank and syphon. Any grease or sediment is intercepted by a trap before reaching the tank.

NEW APPLICATIONS FOR PATENTS.

August 27.—10,944, J. Starley, Screws and Screw-drivers.—10,954, W. Copping, Stay for Casement and other Windows and Doors.—10,960, M. Benedictus, Removing old Paint.

August 28.—10,977, J. Royle, Gas Brackets, Chandeliers, &c.—10,981, W. Moseley, Electric Bells.

August 30.—11,023, F. Wicks, Paving, Flooring, or Building Material.—11,027, J. Sutherland, Ornamentation of Walls, Ceilings, &c.—11,036, F. Northall, Hinges.

August 31.—11,062, W. Johnson, Hinging, Raising, or Lowering Window-sashes.—11,076, J. Morson, jun., Locks for Doors, Windows, &c.—11,086, J. Gsottbauer, Portable Buildings.—11,091, J. Anderson, Bricks, Tiles, &c.—11,092, F. Garon, Securing Door-knobs to Spindles.

Sept. 1.—11,121, H. Harris, Automatically Securing Windows.—11,151, E. Harris, Casement Windows and Metal Frames for same.

Sept. 2.—11,170, J. Watson, Ventilators.—11,171, C. Mapleson and W. Rolls, Monumental Slabs.—11,188, C. Snell, Shovel.

PROVISIONAL SPECIFICATIONS ACCEPTED.

8,747, J. Aniello and Others, Anti-fouling and Preservative Paint or Varnish.—9,396, T. Wood, Controlling the Opening and Shutting of Doors.—9,829, J. Tucker, Window-fastener.—9,881, H. Johnson and T. Bessant, Fastener for Window-Sashes, Doors, &c.—9,935, J. Annandale, Stoves, Fire-grates, Kitchen Ranges, &c. — 10,167, P. Feserich, Artificial Asphalte.—10,207, J. Garvie, jun., Excavators.—6,238, W. Pringle, Cutting, Mitreing, and Cramping up Mitres of Mouldings.—10,139, C. Wharton, Automatic Window Sash-fastener.—10,168, H. Haddan, Door and other Hinges.

COMPLETE SPECIFICATIONS ACCEPTED.

Open to opposition for two months.

10,347, G. Blake, Sash-fastener.—10,378, G. Atkins, Furnace for Burning Stained or Painted Glass.—12,620, F. Morris and J. Fox, Securing Sliding Sashes.—13,115, J. Haylor and Others, Manufacture of White Lead.—13,159, J. Pointon, Anti-fouling and Anti-corrosive Paints or Compositions.—13,891, J. Freeman, White Pigment.—12,164, R. Johnson, Combination Ladder and Steps.—13,130, J. Deeley, Water-closet and Urinal Basins or Pans.—13,327, J. Green, Dry Closets.—13,354, E. Aldous, Water-closets, Baths, Sinks, &c.—13,428, G. Kennedy, Coupling Ladders.—14,981, W. Reid, Pneumatic Chimney Cowl and Ventilator.

RECENT SALES OF PROPERTY.

ESTATE EXCHANGE REPORT.

AUGUST 31.

By VIDLER, SON, & CLEMENTS.

Shortlands, near to—The freehold residence known as "The Valley," and 10a. 3r. 35p. £3,500

By COLLETT & COLLETT.

Notting Hill—64, Silchester-road, 77 years, ground-rent 7l. 10s. 300

SEPTEMBER 2.

By WORSFOLD & HAYWARD.

Kent, near Dover—An enclosure of land, 7a. 1r. 15p., freehold 1,000
Freehold farm house, adjoining 700
Three freehold cottages 400
"Bay Cottage" and "Lavinia Cottage," freehold 860
"Bridge Cottage," and four plots of land, freehold 960

SEPTEMBER 3.

By E CHRISTIAN.

South Hackney—34, Annis-road, 59 years, ground-rent 4l. 250

Science Classes in South London.—For the especial advantage of the working-men of South London science classes are about to recommence at the Royal Victoria Hall, Waterloo-road. The fees are very low, merely nominal, in fact, so as to place them within the means even of the poorest. Classes will recommence in the first week in October in mathematics, geometry, arithmetic, drawing (including machine construction), electricity and magnetism, chemistry, animal physiology, and political economy; that is, provided sufficient students are found to join for each class. Intending students should give in their names at once.

Miscellanea.

Puddling Clay.—It is stated in the *Aberdeen Free Press* that Mr. Thomas Fraser, of King-street, Aberdeen, has discovered a new method of preparing clay for preventing leakage in reservoirs, water tanks, &c., and has taken the necessay steps to have his invention patented. Hitherto it has been the general practice, when clay has been used in connexion with the construction of waterworks, and for other similar purposes, to apply it in a thoroughly wet and plastic condition. From a series of scientifically-conducted experiments, Mr. Fraser has come to the conclusion that far better results can be obtained by drying the clay, and reducing it to a fine powder, before applying it to the bed of a reservoir or to anything which it is desired to render watertight. A long connexion with the brick and tile business led him to study closely the properties of clay, especially when used as a preparation out of which a variety of articles had to be manufactured. He learned from observation that in a wet state clay had reached its extreme point of expansion, and that water would then filter through it. Having ascertained this fact, he concluded that if clay were used for puddling in a dry compressed state it would absorb a certain percentage of water, expansion naturally following, and rendering the layer water-tight. The greater the pressure of water the more satisfactory the results are said to be. Mr. Fraser began his experiments by selecting his clay from a special bed, out of which he cut a square. The specimen was carefully measured and weighed. After it was thoroughly dried, its dimensions and weight were again taken, when it was found that the clay had lost 25 per cent. in weight, while the shrinkage waa 10 per cent. Clay in this dry state is extremely hard and compact, and if put into water and not allowed to expand, it would require a long time before water would penetrate to the centre of a 3-in. tube. Another specimen of clay, from the same bed as the former one, was dried, and reduced to a fine powder. In this loose condition it absorbed about 75 per cent. of the water, which filtered through it. When the clay was prevented from expanding, it was found to absorb 50 per cent. of water, which filtered a little Powdered clay to the depth of 6 in. was pressed into a tube, 8 ft. long by 3 in. in diameter, and having 2 in. of perforated zinc at the bottom. The tube was then filled with water, with the result that the clay absorbed 35 per cent., but there were no traces of filtration. Mr. Fraser is confident that the method he has hit upon, besides being more efficient, is also more economical in every way than the manner of using puddled clay now in vogue. He is sanguine that it could be beneficially applied in covering arches, in preparing a perfect bed for street causewaying, or, in fact, for the prevention of leakage in any description of work that has to be made waterproof from internal or external pressure.

A New Watering-Place and Building Estate in Essex.—The county of Essex is about to have another sea-side resort added to those which it already possesses, and a preliminary step in the promotion of building on the estate took place on Monday last. The Marine and General Land Company have recently purchased a freehold estate at Frinton, known as Frinton Haven. It is situated between Clacton-on-Sea and Walton-on-the-Naze, about three miles distance from the former and a mile and a half from the last-named place. The estate covers an area of between 300 and 400 acres, and stands upon elevated ground, about 60 ft. above the sea level, having a commanding view over the German ocean. Several roads, upwards of twenty in number, are at present in course of formation on the estate. Of these roads, Harold, Cromwell, Holland, Kirby, Handford, and Iddesleigh roads have already been constructed, together with Station-road, which is intended to be the principal business artery in the place. In this road a range of about twenty houses and shops is now in course of erection, also an hotel facing the sea, at the corner of the Marine Parade and Cromwell-road, whilst several houses are likewise in progress of building on other portions of the estate. The esplanade and marine drive facing the sea stretch from east to west to the length of about a mile and a half. Amongst the works about to be carried

* Geol. Mag., vol. iii., p. 529. 1866.

out is a pier upwards of a quarter of a mile in length. A cricket-ground, eight acres in extent, will be provided at the north-east boundary of the estate; whilst at the south-western boundary facing the sea, an area of about twelve acres is to be laid out as pleasure gardens. A very large company left Liverpool-street Station on Monday forenoon to be present at the sale of the first portion of the estate by Messrs. Baker & Sons. The number of lots submitted was 103, for which there was an active and close competition. Four plots on the West Cliff, facing the sea, having frontages of 50 ft., with depths of 160 ft., were sold for 120*l.* each, and two corner plots, also on the West Cliff, having frontages of 80 ft., and return frontages of 190 ft., realised 155*l.* each. No houses of less value than 600*l.* are to be erected on any of these plots. The property offered included 45 shop-plots in Station-road, having frontages of 20 ft. and a depth of 80 ft., which were sold for 35*l.* and 40*l.* each. Twenty plots in the Cromwell-road, having frontages of 50 ft. and depths of 125 ft., realised from 55*l.* to 70*l.* each. Other plots having frontages of 40 ft. and depths of 100 ft., were sold for 40*l.* and 45*l.* each. An hotel plot on the north-east side of the estate, having a frontage of 80 ft. to Station-road, and a return frontage of 125 ft. opposite the railway station, was purchased for 450*l.*, the stipulations providing that the hotel to be erected shall not be of less value than 800*l.* The whole of the plots offered were sold, the total proceeds of the sale amounting to nearly 6,000*l.* The number of houses, shops, and other buildings to be erected on the estate is estimated at about 2,500*l.*

The Liverpool Exhibition.—Messrs. Edw. Smith & Co., of Coalville, write, with reference to our notice of their exhibits at Liverpool (p. 362), to say that the piece of work to which special allusion was made, was composed of tile mosaics and not of glass, as mentioned.

PRICES CURRENT OF MATERIALS.

TIMBER.	£.	s.	d.	£.	s.	d.
Greenheart, B.G. ....ton	6	5	0	7	0	0
Teak, E.I. ....load	9	0	0	14	6	0
Sequois, U.S.....foot cube	0	2	4	0	2	7
Ash, Canada ....load	3	0	0	4	10	0
Birch ,, ...load	2	10	0	4	0	0
Elm ,, ...load	3	10	0	4	10	0
Fir, Dantsic, &c. ....load	1	10	0	4	0	0
Oak ,, ...load	2	10	0	4	10	0
Canada ....load	3	0	0	6	0	0
Pine, Canada red ....load	2	0	0	3	10	0
,, yellow ....load	2	5	0	4	0	0
Lath, Dantsic ....fathom	3	0	0	5	0	0
St. Petersburg ....fathom	4	0	0	5	10	0
Wainscot, Riga.....log	2	15	0	4	0	0
,, Odessa, crown ....log	3	5	0	3	7	6
Deals, Finland, 2nd and 1st...std. 100	7	0	0	8	0	0
,, 4th and 3rd ....std. 100	6	0	0	7	0	0
Riga ....std. 100	5	10	0	7	0	0

TIMBER (*continued*).	£.	s.	d.	£.	s.	d.
Deals, St. Petersburg, 1st yellow ... std. 100	8	0	0	14	0	0
,, 2nd ,, ...std. 100	7	0	0	8	0	0
,, white ....std. 100	7	0	0	10	0	0
Swedish ....std. 100	6	0	0	15	0	0
White Sea ....std. 100	7	0	0	17	10	0
Canada Pine, 1st ....std. 100	17	0	0	30	0	0
,, 2nd ....std. 100	12	0	0	17	0	0
,, 3rd, &c ....std. 100	6	0	0	10	0	0
,, Spruce 1st ....std. 100	8	0	0	11	0	0
,, 3rd and 2nd ....std. 100	5	0	0	7	10	0
New Brunswick, &c....std. 100	5	0	0	7	0	0
Battens, all kinds ....std. 100	4	0	0	12	0	0
Flooring Boards, sq. 1 in., Prepared, first ....sq.	0	9	0	0	13	0
Second ....sq.	0	7	6	0	8	6
Other qualities ....sq.	0	5	0	0	7	0
Cedar, Cuba.....foot	0	0	3	0	0	3½
Honduras, &c. ....foot	0	0	2½	0	0	3½
Australian ....foot	0	0	2	0	0	3
Mahogany, Cuba ....foot	0	0	4	0	0	7
St. Domingo, cargo average ....foot	0	0	4	0	0	7
Mexican ,, ...foot	0	0	3½	0	0	4½
Tobasco ,, ...foot	0	0	4	0	0	6½
Honduras ,, ...foot	0	0	4½	0	0	6½
Maple, Bird's-eye....foot	0	0	6	0	0	8
Rose, Rio ....ton	7	0	0	10	0	0
Bahia....ton	6	0	0	10	0	0
Box, Turkey ....ton	5	0	0	17	0	0
Satin, St. Domingo ....foot	0	0	7	0	0	11
Porto Rico ....foot	0	0	8	0	1	2
Walnut, Italian ....foot	0	0	4	0	0	5
METALS.						
IRON—Pig, in Scotland ....ton	0	0	0	0	0	0
Bar, Welsh, in London....ton	4	7	6	4	15	0
,, ,, in Wales ....ton	4	2	6	4	7	6
,, Staffordshire, London ....ton	5	10	0	6	0	0
Sheets, single, in London....ton	6	15	0	8	10	0
Hoops ,, ...ton	6	0	0	7	0	0
Nail-rods ,, ...ton	5	10	0	6	10	0
COPPER—						
British, cake and ingot ....ton	42	0	0	43	0	0
Best selected ....ton	42	10	0	43	10	0
Sheets, strong....ton	47	0	0	48	0	0
,, India ....ton	44	10	0	45	10	0
Australian ....ton	0	0	0	0	0	0
Chili, bars ....ton	39	2	6	39	10	0
YELLOW METAL.....lb.	0	0	3½	0	0	4½
LEAD—						
Pig, Spanish ....ton	12	17	6	0	0	0
English, common brands....ton	13	2	6	13	5	0
Sheet, English ....ton	14	0	0	14	2	6
SPELTER—						
Silesian, special ....ton	13	17	6	14	0	0
Ordinary brands ....ton	13	12	6	13	15	0
TIN—						
Banca ....ton	0	0	0	0	0	0
Billiton ....ton	0	0	0	0	0	0
Straits ....ton	99	0	0	0	0	0
Australian ....ton	99	15	0	0	0	0
English ingots....ton	103	0	0	0	0	0
ZINC—						
English sheet ....ton	18	0	0	18	5	0
OILS.						
Linseed ....ton	21	15	0	22	0	0
Cocoanut, Cochin ....ton	32	15	0	33	0	0
Ceylon ....ton	25	10	0	25	15	0
Copra....ton	0	0	0	0	0	0
Palm, Lagos ....ton	23	0	0	23	10	0
Palm-nut Kernel ....ton	0	0	0	0	0	0
Rapeseed, English pale....ton	22	0	0	0	0	0
,, brown ....ton	20	10	0	0	0	0
Cottonseed, refined ....ton	19	10	0	20	0	0
Tallow and Oleine ....ton	25	0	0	45	0	0
Lubricating, U.S. ....gal.	6	0	0	10	0	0
,, Refined ....gal.	8	0	0	13	0	0
TURPENTINE—						
American, in casks....cwt.	1	6	6	1	6	9
TAR—Stockholm ....barrel	0	15	0	0	15	6
Archangel....barrel	0	10	6	0	11	0

COMPETITIONS, CONTRACTS, & PUBLIC APPOINTMENTS.

Epitome of Advertisements in this Number.

COMPETITIONS.

Nature of Work.	By whom required.	Premium.	Designs to be delivered.	Page.
School Buildings	Sunderland School Brd.	50*l.*, 20*l.*, and 10*l.*	Sept. 25th	i.

CONTRACTS.

Nature of Work, or Materials.	By whom required.	Architect, Surveyor, or Engineer.	Tenders to be delivered.	Page.
Five Warehouses, Manchester	....	Pennington & Bridgen	Sept. 14th	xiii.
Broken Granite	East Ham Local Brd.	W. H. Savage	do.	ii.
New Offices, Westminster Bridge-road	Rock Freehold Land Soc.	....	Sept. 15th	ii.
Three Houses and Shops, Peckham....	J. Barrow	J. B. Wotton	do.	xiii.
House at Dunsfold, Surrey	S. Barrow....	T. R. Hooper	Sept. 16th	ii.
New Police Station	Recevr. Met. Police Dis.	*Official*	Sept. 18th	ii.
Erection of Dwelling-house, &c.	....	J. Colson & Son	do.	ii.
Reservoir, &c....	Horsforth Waterworks Co....	McLandsborough & Preston....	Sept. 20th	ii.
Roof over Reservoir	Guildford U. S. A.	*Official*	do.	ii.
Road Repairs and Tar-Paving	Acton Local Board.....	C. N. Lailey	Sept. 21st	ii.
Repairs, New Cisterns, Painting, &c....	Guardians, St. Matthew Bethnal Green	T. & W. Stone	do.	ii.
Erection of Infirmary, &c., Wards	Brentford Local Board	E. Monson, Jun....	Sept. 22nd	ii.
Stables	Walthamstow Lcl. Brd.	G. B. Jerram....	Sept. 23rd	ii.
Stores	Great Western Ry. Co.	*Official*	October 4th	ii.
Exhibition Buildings, Newcastle-upon-Tyne...	Executive Council	W. Glover	Not stated...	ii.

PUBLIC APPOINTMENTS.

Nature of Appointment.	By whom Advertised.	Salary.	Applications to be in.	Page.
Outdoor Superintendent	Stockton Corporation ..	104*l.*	Sept. 13th	xvi.
Two Clerks of the Works	Manchester Jubilee Ex.	Not stated	Sept. 14th	xvi.
Clerk of Works	Civil Service Com.	do.	October 7th	xvi.

TENDERS.

AYLESBURY.—For building bell turret, altering west front, and reseating Walton Church, Aylesbury. Mr. Brett A. Elphicke, architect, Great Queen-street, Westminster:—

Honor & Sons	£903 0 0
Priestley & Gurney....	893 0 0
Mayne & Son	891 0 0
Cooper & Co....	878 14 0
J. N. Landon	850 10 0
Thos. Green	797 0 0
S. Greist (accepted)	658 0 0

[Architect's estimate, 705*l.*]

BERMONDSEY.—For building house and premises, 4, Parfitt-road, for Mr. Francis. Mr. Edward Thomas, architect:—

Parfitt....	£745 0 0
Almond	720 0 0
White & Co.	671 0 0
Chafen (accepted)	585 0 0

[Architect's estimate, 616*l.*]

CAMBERWELL.—For the erection of a mission hall, &c., at Nelson-street, Avenue-road, Camberwell, for the Building Committee. Messrs. Wagstaff & Warman, architects, Highbury Corner. Quantities supplied:—

	Mission Hall.	Less allowance for old materials.	Net amount of estimate.
Steer	£1,595 ...	£12 10 ...	£1,582 10
Higgs & Hill	1,484 ...	Nil. ...	1,484 0
Thos. Wontner Smith & Son (accepted) ...	1,479 ...	25 0 ...	1,454 0
Thompson & Son	1,306 ...	10 0 ...	1,296 0

CHARD (Somerset).—For the erection of dwelling-house for Mr. Charles Plaster, from plans by Mr. Henry J. Lye, Crewkerne:—

		Ham stone extra.
E. J. Symes, Coombe, St. Nicholas	£400	£10 0
F. Hill, Chard....	395	7 0
Lye & Sons, Crewkerne	351	16 7
J. S. Harbour, Chard	350	Not stated
A. Poole, Ilminster	340	17 10
Cotterell, Chard (accepted) ...	280	12 0

CROYDON.—For the erection of new depôt for the London Parcels Delivery Company, Limited. Mr. W. Seckham Witherington, F.R.I.B.A., architect, Mark-lane:—

Russell & Ball, Sutton	£2,553 0 0
Keasley	2,493 0 0
Elkington	4,430 0 0
Potter, Sutton	2,390 0 0
Barton, Croydon	2,038 0 0
Priestley....	1,966 0 0
Patman & Fotheringham	1,945 0 0

[Architect's estimate, 1,934*l.*]

DARTMOUTH.—For alterations to Sea View House, Dartmouth. Mr. E. H. Back, architect, Dartmouth. Quantities supplied:—

Maunder....	£138 9 0
Winsor	135 19 0
Williams (accepted)	119 0 0

[All of Dartmouth.]

DARTMOUTH. — For additions to Ford Bank Villa, Dartmouth, for Mr. W. Smith. Mr. E. H. Back, architect, Dartmouth. Quantities supplied:—

Pillar	£640 18 8
W. H. Oldrieve	626 0 0
Row & Grant....	564 0 0
Winsor	503 10 0
Williams....	487 0 0
Henley (accepted)	446 0 0

[All of Dartmouth.]

DEAL.—For erection of New Purifier House, Deal Gas Works:—

Wise, Deal....	£435 0 0
W. & T. Denne, Walmer	419 0 0
Denne, Deal	392 0 0
Trollope, Walmer	375 0 0
Cottew, Deal (accepted)	372 18 6

EALING. — For the erection of east wing of new warehouse in Broadway, Mr. J. Saunders. Mr. George Ashby Lean, architect, Ealing, W. Quantities by the architect:—

Nye, Ealing	£3,498 0 0
Toms, Camden Town	3,474 0 0
Waters, Ealing....	3,431 0 0
Bywaters, Regent-street....	3,395 0 0
J. & S. Bowyer, Dulwich	3,395 0 0
Prestige & Co., Pimlico	3,390 0 0
Adamson & Sons, Ealing	3,291 0 0
Bailey, Ealing	3,245 0 0
Perry & Co., Ealing	3,235 0 0
Johnson, Wandsworth Common	3,230 0 0
Shepperd, Bermondsey	3,195 0 0

HAMMERSMITH.—For alterations at Nos. 28 and 30, King-street, Hammersmith, W., for Messrs. Smith & Co. Mr. Stanley Parker, architect, Edgware-road, W.:—

Neighbour....	£486 0 0
White	436 0 0
Petchy....	419 0 0

HORSELYDOWN.—For providing lunatic wards at the Workhouse, Parish-street, Horselydown, for the Guardians of the Poor of St. Olave's Union. Messrs. H. Saxon Snell & Son, architects, London:—

	With padded rooms.	Without padded rooms.
J. & J. Greenwood	£486 0	£254 0
C. Batcheldor	453 0	243 0
J. Almond	472 10	231 0
A. White & Co.	471 0	227 0
G. Gaisford	437 0	222 0
J. Bullers (accepted)	425 0	215 0

LEOMINSTER.—For the erection of new shop and business premises, Victoria-street. Mr. W. W. Robinson, architect, King-street, Hereford:—

Page & Son, Leominster	£750 0 0

LONDON.—For alterations and repairs to 84-86, Oxford-street, for Messrs. Beare, Gosnell, & Co. Mr. E. Flint, A.R.I.B.A., architect:—

Greenwood	£2,432 18 0
Corbett	2,393 17 0
Hall, Beddall, & Co.	2,270 12 0
Bush	2,007 6 0

LONDON.—For alterations at 1, Love-lane, and 34 and 35, Wood-street, for Messrs. Virgoe, Middleton, & Co. Mr. C. W. Chapman, architect:—

Neave & Neave	£269 0 0
Taylor	243 0 0
Staines & Son	194 0 0

MARYLEBONE.—For new floor and roof, foundations for machinery, &c., at the Public Baths and Washhouses, Marylebone-road, for the Commissioners. Mr. Jno. Waldram, C.E., surveyor, Craven-street, Charing Cross:—

J. G. B. Marshall, Brighton	£1,850 0 0
John Oliver, Camberwell	1,792 0 0
G. S. S. Williams & Son, Barnsbury	1,784 0 0
John Hicks, Stamford Hill	1,780 0 0
T. W. Smith & Son, Islington	1,769 0 0
L. H. & R. Roberts, Islington	1,765 0 0
Grover & Son, New North-road*	1,738 0 0
H. S. Stephens, New North-road	1,642 0 0

[Surveyor's estimate, 1,745*l.*]
* Accepted.

MARYLEBONE.—For engine, laundry machinery, &c., at the Public Baths and Washhouses, Marylebone-road, N.W., for the Commissioners. Mr. Jno. Waldram, engineer, Craven-street, Charing Cross:—

Coalbrookdale Co., Limited	£5,980 0 0!
Walker, Tewkesbury	2,002 0 0
Gimson & Co., Leicester	1,490 0 0
Goddard & Massey, Nottingham	1,405 0 0
F. Brown & Co., Upper George-street, W.	1,398 0 0
Crowther & Co., Huddersfield	1,375 0 0
T. Murdock & Co., Glasgow	1,300 0 0
W. J. Fraser & Co., Commercial-road	1,258 0 0
Best & Co., Dockhead	1,245 0 0
J. & F. May, High Holborn	1,196 0 0
Bradford & Co., 140, High Holborn	1,192 0 0
Fraser & Fraser, Bow	1,183 0 0
Watford Engineering Co., Watford	1,125 0 0
Manlove, Alliott, & Co., Nottingham*	1,122 0 0!

[Engineer's estimate, 1,250*l.*]
* Accepted.

NORWOOD.—For the erection of out-buildings and other works at Norwood Schools, for the Lambeth Board of Guardians. Mr. Sidney R. J. Smith, architect (Messrs. Catt & Smith), Furnival's Inn:—

Hitchcock	£1,290 0 0
Paine Bros.	1,260 0 0
Burman & Son	1,257 0 0
W. H. Castle	1,250 0 0
John W. Sawyer	1,222 0 0
Leeks & Hooker	1,222 0 0
Wallis Bros.	1,206 0 0
G. Veale	1,174 0 0
Turtle & Appleton	1,170 0 0
F. Higgs	1,149 0 0
Chas. Robson	1,148 0 0
J. Holloway	1,143 0 0
Chas. F. Kearley	1,141 0 0
G. Jervis Smith	1,136 0 0
George Roberts	1,127 0 0
R. G. Battley	1,097 0 0
W. Martin	1,095 0 0
Chas. Fox	1,092 0 0
W. Smith	1,086 0 0
W. Johnson	1,080 0 0
Geo. Parker	1,075 0 0
J. O. Richardson	1,058 0 0
Woolgar & Son	1,030 0 0
A. M. Deacon & Co. (accepted)	1,020 0 0
Smith & Ballard	898 0 0

PECKHAM.—For alterations and additions to the Montpelier Tavern, Choumert-road, Peckham, for Mr. F. E. Pow. Mr. Arthur W. Saville, architect, Strand. Quantities supplied:—

Wm. Oldrey	£1,185 0 0
Burch & Co.	1,141 0 0
Walker	1,134 0 0
Moreton	1,100 0 0
Cook	1,096 0 0
Ward & Lamble	969 0 0
Spencer & Co.	947 0 0
Trewecke	898 0 0

ROTHERHITHE.—For paving the carriageway of Rotherhithe New-road and Raymouth-road with 4 in. by 9 in. Guernsey cubes, re-laying curb and footways, for the Rotherhithe Vestry. Mr. Edward Thomas, surveyor:—

	Contract No. 1.	Contract No. 2.	Total.
Hindle & Morris	£3,500	£1,690 0	£5,190 0
Bevers	3,395	1,600 0	4,995 0
Carey	2,827	1,609 10	4,436 10
Mowlem & Co.	2,765	1,660 0	4,425 0
Etheridge	2,717	1,432 0	4,149 0
Turner & Son	2,620	1,210 0	3,830 0

[Surveyor's estimate, 4,200*l.*]

SOUTHAMPTON.—For pulling down and rebuilding No. 29, East-street, Southampton, for Mr. Edwin Jones, J.P. Mr. James Lemon, F.R.I.B.A., architect:—

Brinton & Bone, Southampton	£2,100 0 0
Stevens & Sons, Southampton*	1,994 0 0

[Architect's estimate, 2,100*l.*]
* Accepted.

SOUTHGATE (Middlesex).—For erecting four shops at Bunker's Corner, High-street, Southgate. Mr. W. Smith, architect, Gresham-buildings:—

Clark Bros.	£1,530 0 0
Sheel Bros.	1,526 0 0
Mattock Bros.	1,510 0 0
Say	1,497 0 0
Lanham	1,494 0 0
Dearing & Son	1,475 0 0
Ward	1,469 0 0
Newby	1,425 0 0
Lark	1,390 0 0
Wheeler	1,320 0 0

TOXTETH PARK.—For the reconstruction of the carriageway of Smithdown-road, between Salisbury and Wellington roads (Contract No. 3), for the Toxteth Local Board. Quantities supplied by the engineer, Mr. John Price, Assoc.M.Inst.C.E.:—

Catterall & Co., Liverpool	£1,567 14 0
Ireland & Hurley, Liverpool	1,147 18 6
J. Garnett, Liverpool	1,106 7 3
McCabe & Co., Liverpool	1,079 5 0
R. Lomax, Toxteth Park	1,062 17 9
R. B. Ballantine, Everton	1,038 18 7
W. F. Inglis, Liverpool	964 12 0
Walkden & Co., Bootle	938 0 0
L. Marr, Toxteth Park	917 15 1
Jas. Evans, Parkgate (accepted)	860 16 11

[Engineer's estimate, 950*l.*]

TOXTETH PARK.—For curbing and channelling Smithdown-road between Wellington and Ullet roads, for the Toxteth Park Local Board. Quantities supplied by the engineer, Mr. John Price, Assoc. M. Inst. C.E.:—

J. Garnett, Toxteth Park	£462 5 5
Ireland & Hurley, Liverpool	412 14 6
R. B. Ballantine, Everton	388 3 6
W. F. Inglis, Liverpool	379 8 7
McCabe & Co., Liverpool	378 0 0
R. Lomax, Toxteth Park	347 3 4
Jas. Evans, Parkgate	333 11 0
Walkden & Co., Bootle	329 0 0
Catterall & Co., Liverpool	309 10 6
L. Marr, Aspen Grove, Toxteth Park*	305 3 9

[Engineer's estimate, 350*l.*]
* Accepted.

UPTON (Essex).—For five shops for Mr. Baines, Green-street, Upton Park. Mr. H. Bethell, architect:—

James Baxter, Upton	£2,460 0 0
Parsons, Plashet	2,300 0 0
James Wyles, Upton Park	2,299 0 0
Allerton & Fox, West Ham*	2,250 0 0

* Accepted.

WOODFORD (Essex).—For a pair of villa residences at Woodford Green, for Mr. J. R. Roberts. Mr. J. K. Cole, architect:—

Wood Bros.	£3,883 0 0
J. Eagen	3,683 9 0
T. Little	3,582 0 0
Wells	3,530 0 0
Williams & Son	3,529 0 0
Perry & Co.	3,460 0 0
Wall Bros	3,375 0 0
J. O. Richardson	3,364 0 0
J. Bentley	3,257 0 0

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